FINAL

2017 REMEDIAL INVESTIGATION REPORT ADDENDUM
OPERABLE UNIT 3
LIBBY ASBESTOS SUPERFUND SITE, LIBBY, MONTANA

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TITLE AND APPROVAL SHEET – TO BE SIGNED FOR FINAL VERSION ONLY

Title: 2017 Remedial Investigation Report Addendum Operable Unit 3, Libby Asbestos Superfund Site, Libby, Montana

Approvals:

This 2017 Remedial Investigation Report Addendum is approved for implementation without conditions.

for

10/3/2018

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LIST OF ACRONYMS AND ABBREVIATIONS

®	Registered
%	percent
ºF	degree Fahrenheit
Ms/g	million structures per gram
s/cc	structure/cubic centimeter
ABS	Activity Based Sampling
ACB	Air Curtain Burner
AOC	Administrative Settlement Agreement and Order on Consent
APTIM	APTIM Federal Services, LLC
ASTM	American Society for Testing and Materials
BH	Borehole
BLM	Bureau of Land Management
CDM Smith	CDM Smith Federal Programs Corporation
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	chain of custody
CTP	Coarse Tailings Pile
Dbh	diameter at breast height
EDD	electronic data deliverable
EPA	U.S. Environmental Protection Agency
ETRB	External Technical Review Board
FS	Feasibility Study
FSDS	field sample data sheet
FSSR	Field Sampling Summary Report
Grace	W.R. Grace & Co.-Conn
GPS	global positioning system
HHRA	Human Health Risk Assessment
ID	identification number
ISO	Internal Organization for Standardization
KDC	Kootenai Development Company
KDID	Kootenai Development Impoundment Dam
LAA	Libby Amphibole Asbestos
MALM	Misse a la Masse
MASW	multi-channel analysis of surface waves
MC	Modified California
Mph	miles per hour
MWH	MWH Americas, Inc.
NIST	National Institute of Standards and Technology
NSPS	New Source Performance Standards
NVLAP	National Voluntary Laboratory Accreditation Program
OU3	Operable Unit 3

pcf	pounds per cubic foot
PCM	Phase Contrast Microscopy
PCME	Phase Contrast Microscopy-Equivalent
psi	pounds per square inch
PVC	polyvinyl chloride
QA	Quality Assurance
QA/QC	Quality Assurance/Quality Control
QATS	Quality Assurance Technical Support
QC	Quality Control
OSHA	Occupational Safety and Health Administration
PEL	Permissible exposure limit
RI	Remedial Investigation
ROM	Record of Modification
SAP/QAPP	Sampling and Analysis Plan/ Quality Assurance Project Plan
SOP	Standard Operating Procedure
SOW	Statement of Work
SPT	Standard Penetration Test
SSF	Soil Surface Factor
Stantec	Stantec Consulting Services, Inc.
TEM	Transmission Electron Microscopy
USCS	Unified Soil Classification System
WRP	Waste Rock Pile

1 INTRODUCTION

This report is an addendum to the Remedial Investigation (RI) Report, Operable Unit 3 (OU3) Study Area, Libby Asbestos Superfund Site, Libby, Montana (OU3 RI Report) [MWH Americas, Inc. (MWH), 2016]. This addendum presents the results and conclusions for OU3 Remedial Investigation (RI) related activities performed during 2017 and the first quarter of 2018, after the OU3 RI Report was finalized. The objective of the field activities was to fill data gaps to support the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Feasibility Study (FS) process for OU3 and to characterize subsurface conditions in the former mine area.

The field activities conducted in 2017 and 2018 that are discussed in this report include the following:

- Air curtain burner (ACB) treatability study;
- Cover treatability study;
- Winter hooking/skidding activity based sampling (ABS) study (performed in 2018); and
- Geotechnical and hydrogeological investigations.

The data collected during the 2017 treatability studies will be used to support the Phase 1 FS. The goal of the ACB treatability study was to evaluate the implementability of burning green/unseasoned slash in an ACB by collecting site-specific data on the operating conditions, volume throughput, emissions (visual smoke opacity and Phase Contrast Microscopy Equivalent [PCME] Libby Amphibole Asbestos [LAA] in perimeter air), and total LAA concentrations in the resulting ash. The goal of the cover treatability study was to evaluate the effectiveness of two cover materials, including augmented vegetation (e.g., hydroseeding) and biomass (e.g., masticated wood) materials.

The winter hooking/skidding ABS was conducted to evaluate whether winter conditions (e.g., snow cover and/or frozen ground) reduce the potential for entrainment of LAA in air from the forest floor during hooking/skidding activities relative to summer conditions (e.g., dry, dusty, exposed ground). Winter ABS hooking/skidding data were compared with the summer ABS hooking/skidding data collected in 2016 to support a potential institutional control in the Phase 1 forested area to limit commercial loggers' exposure to LAA.

Stantec Consulting Services, Inc. (Stantec) conducted a geotechnical field investigation within the former mine area to characterize the subsurface conditions in support of engineering analysis and evaluations of potential remedial alternatives for the Kootenai Development Impoundment Dam (KDID), waste rock piles (WRPs), and coarse tailings pile (CTP). The investigations were performed to improve the understanding of geotechnical and hydrogeological conditions within the former mine area and to address data gaps identified through discussions with the OU3 project stakeholders and the project External Technical Review Board (ETRB).

The RI, FS, and geotechnical related activities were conducted, and this RI Addendum was prepared, in accordance with the revised Statement of Work (SOW) dated December 2015 of the Administrative Settlement Agreement and Order on Consent (AOC) (Docket No. CERCLA-08-2007- 0012) between W.R. Grace & Co.-Conn (Grace) and the U.S. Environmental Protection Agency (EPA) (EPA, 2007 and EPA, 2015a).

2 SUMMARY OF 2017 AND 2018 LAA-RELATED FIELD STUDIES

This section summarizes the data collection and management protocols, study designs and sample collection details for the 2017 and 2018 LAA-related field studies, including the Phase 1 treatability studies and the 2018 winter hooking/skidding ABS Study. The field studies were performed in accordance with the following documents:

- Sampling and Analysis Plan / Quality Assurance Project Plan (SAP/QAPP), Phase 1 Feasibility Study 2017 Treatability Studies – Libby Asbestos Superfund Site, Operable Unit 3 (Phase 1 TS SAP/QAPP; Stantec, 2017a)
- Sampling and Analysis Plan / Quality Assurance Project Plan Addendum, Winter Hooking/Skidding ABS Study – Libby Asbestos Superfund Site, Operable Unit 3 (2018 Winter ABS SAP/QAPP Addendum; Stantec, 2018a)

Detailed sampling methodologies, protocols, and analytical testing methods for each of the studies were presented in the above documents.

The Phase 1 treatability studies included two individual studies: ACB treatability study and cover treatability study. Detailed results and a thorough data evaluation of the treatability studies are included in the *Final Treatability Studies Technical Report, Phase 1 Feasibility Study, Operable Unit 3, Libby Asbestos Superfund Site, Libby, Montana* (Phase 1 TS Technical Report; Stantec, 2018b) with supporting information in the *2017 Field Sampling Summary Report* (2017 FSSR; Stantec, 2018c). A brief summary of field activities, results, and conclusions of the treatability studies are provided in this addendum.

A detailed data evaluation for the 2018 winter hooking/skidding ABS study is provided in this addendum. Information provided includes a summary of field activities, results, and conclusions.

2.1 DATA COLLECTION AND MANAGEMENT

2.1.1 Sampling Overview

Field samples collected and analyzed for LAA during the field studies include the following (see **Table 2-1**):

- One ash sample from the ACB treatability study
- Eight perimeter air samples from the ACB treatability study
- Seventy-two ABS air samples from the cover treatability study
- Five ABS air samples from the winter hooking/skidding ABS study

Sample totals per media and sample specifics including station information are presented on **Tables 2-1** and **2-2**, respectively. **Table 2-2** also includes the station identification numbers (ID), and station descriptions. Further details on each sample event design and collection are presented below in **Sections 2.2** through **2.4**. Sample results are discussed in **Section 4.0** by study.

2.1.2 OU3 Database

As described in Section 3.3 of the OU3 RI Report, all OU3-related analytical data are entered and maintained in the master OU3 project database (relational Microsoft Access® database), which is managed by CDM Smith Federal Programs Corporation (CDM Smith). The 2017 and 2018 LAA data were entered into this relational database under the same guidance as previous datasets.

2.1.3 Analytical Methods

As described in Section 3.5 of the OU3 RI Report, the EPA has employed modifications to commercial asbestos test methods for various sample media collected in OU3. The analytical methods used to analyze the OU3 LAA samples by media are shown on Table 3-1 of the OU3 RI Report and discussed in the SAP/QAPPs. For the 2017 and 2018 sampling, transmission electron microscopy (TEM) – in accordance with International Organization for Standardization (ISO) 10312.1995(E); referred to as TEM ISO, was the analytical method for all sample media.

2.1.4 Quality Assurance (QA)/Quality Control (QC) Activities

Field QA Activities: Field QA activities include processes and procedures that have been designed to confirm that field samples are collected and documented properly, and that issues/deficiencies associated with field data collection or sample processing are quickly identified and rectified. Field QA activities for the 2017 and 2018 field studies are summarized here:

- Before beginning the field activities, all field team members were required to read and become familiar with the applicable SAP/QAPPs, the applicable SOPs for sampling, documentation, decontamination, etc., and the project health and safety plans.
- Readiness calls that included stakeholders and field and management personnel were held to outline the project specifics and to answer any questions prior to conducting field activities.
- A project kickoff H&S meeting and daily H&S tailgate meetings were held before on-site mobilization with field team members and oversight personnel to discuss daily activities and any H&S related issues.
- An EPA contractor from CDM Smith was on-site during the treatability studies and the winter hooking/skidding ABS study to provide oversight and QA assistance for the sampling methodologies and procedures as described in the SAP/QAPPs.
- Where applicable, equipment used for sampling and monitoring was decontaminated in accordance with OU3 SOP No. 7, Equipment Decontamination, between all sample locations.
- All samples were labeled and recorded on the appropriate chain-of-custody (COC) forms as physical evidence of sample custody and control. All samples were also recorded on the field sample data sheet (FSDS) and in a field log book.
- Record of Modification (ROM) forms that modified the sampling approach and/or associated guidance were prepared to document changes to or deviations from the SAP/QAPPs and are included in the 2017 FSSR as attachments. Note that no ROMs were required for the winter hooking/skidding study.

Field and Laboratory Audits: Field audits for the 2017 treatability studies and 2018 winter hooking/skidding ABS study were conducted during the health and safety kickoff meetings by an EPA representative (Mike Cirian), and during the entire field evaluation by an EPA contractor, CDM Smith (Jim Sabo and Damon Repine during the treatability studies; Simon Wilson and

Damon Repine during the 2018 winter hooking/skidding ABS study). The audits were performed to confirm that the SAP/QAPP and applicable Standard Operating Procedures (SOPs) were being followed during the field investigation and to alert the field team of any potential data quality issues and/or deviations from the approved sampling methodologies. If identified, quality or procedural issues, including potential modifications to sampling methodologies, were discussed in the field with the involved personnel and on follow-up calls with Stantec and EPA where necessary. In the event of an identified deviation from the SAP/QAPP and/or SOPs, Stantec initiated a corrective action immediately.

On-site audits of all five asbestos laboratories and the soil preparation facility (SPF) used by EPA for analytical support at the Libby Superfund Site were conducted in 2017. On-site audits are used by EPA to verify that samples analyzed by their contract facilities are processed in accordance with EPA requirements. Each on-site audit involves the general elements of preparation, OU3 on-site support, and report generation, which are modified as needed to fit the type of audit being performed. A total of 10 deficiencies were identified at the five laboratories and two deficiencies at the SPF, with each laboratory and the SPF proposing corrective actions that will be verified during the next round of scheduled audits. Details on laboratory audit results can be found in the 2017 Annual QA/QC Summary Report by APTIM (APTIM Federal Services, LLC, 2018) (see **Attachment A**).

Data Verification: Data verification includes checking that results have been transferred correctly from the original hand-written, hard copy, field and analytical laboratory documentation to the OU3 project database. The goal of data verification is to identify and correct data reporting errors. For analytical laboratories that utilize the Libby-specific electronic data deliverable (EDD) spreadsheets, data checking of reported analytical results begins with automatic QC checks that have been built into the spreadsheets. Data verification was performed by CDM Smith staff familiar with project-specific data reporting, analytical methods, and investigation requirements. During data verification, any field documentation data issues identified by CDM Smith were relayed to Stantec for correction and form resubmittal so that sample collection information could be entered correctly into the OU3 database.

Results of data verification for the 2017 treatability studies can be found in Sections 2.3 and 3.3 of the Phase 1 TS Technical Report (Stantec, 2018b) and also are summarized here. A manual data verification review was performed by CDM Smith for data collected as part of the 2017 treatability studies. Due to the low number of analyses in the ACB treatability study, 100 percent (%) of the ACB treatability study results, instead of 10% as specified in the Phase TS Study SAP/QAPP, were verified. A laboratory benchsheet error was identified and the laboratory was notified and corrected the error. Detailed results of the manual data verification are included in the TEM Consistency Review and Data Transfer Verification Reports for 2017 Treatability Studies (see **Attachment B**). For the Cover treatability study, 13 air analyses were selected for verification. No errors or discrepancies were identified.

Results of data verification for the 2018 winter hooking/skidding ABS study can be found in the TEM Consistency Review and Data Transfer Verification Reports for 2018 Winter Hooking/Skidding Activity-Based Sampling Study (see **Attachment C**). No data errors or discrepancies were identified during the verification effort.

Laboratory QA Activities: Laboratories selected for analysis of samples for asbestos are part of the Libby analytical laboratory team. These laboratories have demonstrated experience and expertise in analysis of LAA in environmental media, and are part of an ongoing Libby-specific

QA program designed to ensure accuracy of analytical and consistency of reported analytical results between laboratories. These laboratories are audited by the EPA Quality Assurance Technical Support (QATS) contractor, APTIM, and the National Institute of Standards and Technology (NIST)/National Voluntary Laboratory Accreditation Program (NVLAP) on a regular basis. Laboratory QA activities include processes and procedures that have been designed to ensure that data generated by an analytical laboratory are of high quality and that any problems in sample preparation or analysis that may occur are quickly identified and rectified. A summary of the laboratory QA procedures that are required of each laboratory that analyzes samples from OU3 is included in Section 3.6 of the OU3 RI Report.

A detailed evaluation of the QC results for the treatability studies was performed by APTIM including a formal data validation. The results of this evaluation are presented in the 2017 Annual QA/QC Summary Report (APTIM, 2018) (see **Attachment A**). A detailed evaluation of the field and laboratory QC sample results for the 2018 winter hooking/skidding study will be prepared by APTIM and presented in the forthcoming 2018 Annual QA/QC Summary Report. Field and laboratory QC sample results and data validation results are described below.

Field and Laboratory QC Sample Results

There are a variety of field quality control (QC) samples, preparation laboratory QC samples, and analytical laboratory QC analyses (see investigation-specific SAP/QAPPs for requirements), included as part of the sampling investigations performed at OU3. A more detailed summary of the QC results as evaluated by APTIM is as follows:

- **Field Lot Blanks** – Lot blanks were collected for air samples only. During the 2017 treatability study activities, four air filter lot blanks were analyzed by TEM and no asbestos structures were observed. Based on the lot blank results, the air filters used during the field sample collection did not contain asbestos.
- **Field Blanks** – Field blanks were collected for air samples only. During the 2017 treatability study activities, five field blanks were analyzed by TEM and no asbestos structures were observed. Based on the field blank results, the potential contamination was not introduced during sample collection, shipping and handling, or analysis.
- **Laboratory Blanks** – A total of 19 laboratory blanks were analyzed for the treatability studies in 2017. No asbestos structures were found in any of the laboratory blank samples. The results verify that asbestos contamination was not introduced during sample preparation and analysis in the TEM laboratories.
- **Laboratory Re-preparation Analysis** – A TEM re-preparation is the re-analysis of a sample from which new grids have been prepared using a different portion of the same field sample filter used to prepare the original grids. Re-preparation analyses provide information on analysis precision and within-filter variability. Re-preparation analyses are compared to the original analysis using the two Poisson rates ratio method for statistical comparison. Three sample re-preparation analyses were performed for the 2017 treatability studies; none were found to be statistically different from the original analyses. The results show good analysis precision and low within-filter variability.
- **Laboratory Recount Analyses** – A recount analysis is an intra-laboratory re-examination of the original TEM grid openings by the same and a different microscopist to verify the reproducibility of results within the laboratory. Recount

analyses include recount same, recount different, and verified analyses. Recount analyses were compared with the original analyses on a grid-opening-by-grid-opening and structure-by-structure basis. Grid opening concordance is evaluated based on a comparison of total structure count. Structure concordance is evaluated based on a comparison of the assigned mineral classification and recorded structure dimensions. A total of 12 recount analyses were performed for the treatability studies in 2017. The overall recount attributes for mineral class, concordance on LAA structure count per grid opening, structure length, and structure width were in the "good" category, and concordance on mineral class was in the "poor" range at 0%.

- **Laboratory Inter-laboratory Analyses** – Inter-laboratory analyses are recount analysis types in which grid openings are re-examined by a different laboratory than the one that performed the original analysis. Inter-laboratory analyses are compared in the same way as recount samples. Inter-laboratory analysis samples include two air samples for the ACB treatability study, and three air samples for the cover treatability study. Inter-laboratory sample pair analyses were within the "good" range for program-wide criteria specified for asbestos class of structure, structure length, structure width, and structures per grid opening.

Data Validation

The goal of data validation is to evaluate overall data quality and to assign data qualifiers, as appropriate, to alert data users to potential data quality issues within the subset of the data evaluated.

Results of data validation for the 2017 treatability studies can be found in Sections 2.3 and 3.3 of the Phase 1 TS Technical Report (Stantec, 2018b) and are summarized here. For the ACB treatability study, because of the small number of samples associated with the study, results of all the perimeter air samples and the field blank (rather than 10% of the data as specified in the Phase 1 TS Study SAP/QAPP) were validated. The field blank sample was non-detect for asbestos. The validation reports concluded the laboratory data deliverables were found to be complete and accurate and no qualification of the data was required. Data validation for the cover treatability study also was performed by APTIM on 10 of the ABS air samples. In summary, the validation reports concluded the laboratory data deliverables were found to be complete and accurate and no qualification of the data was required.

Data validation for the 2018 winter hooking/skidding ABS study also was performed by APTIM on all of the ABS air samples. The bench sheet/EDD information comparisons found one minor discrepancy regarding the identification of a grid opening. The discrepancy did not have any impact on the sample results.

The results of the data validation evaluations are presented in the 2017 Validation Data Reports (APTIM, 2017) which are included in **Attachment D**.

2.2 2017 ACB TREATABILITY STUDY

2.2.1 Objectives

The ACB treatability study was conducted in the summer of 2017 to evaluate the implementability of the ACB technology in reducing the volume of slash (cut trees, branches, etc.) generated during fuels management in OU3. Various fuels management activities are under review to decrease fuel sources in the Phase 1 area of OU3, which will reduce the likelihood and potential severity of wildfires. These fuels management activities are likely to generate considerable quantities of slash, which could become a fire hazard depending on assembly and if left in place. One technology being considered to reduce the volume of slash generated during fuels management is air curtain burner (ACB). ACBs blow high-velocity air (curtain) across and into the unit's combustion chamber, which in turn generates a rotational air current within the unit. The curtain of air oxygenates the fire and entraps the particulates (smoke), which results in higher burn temperatures, more complete combustion of materials, and low smoke output. Results of the ACB treatability study will support the screening and detailed analysis of components of the remedial alternatives for the OU3 FS.

2.2.2 Field Activities

A summary of ACB treatability study activities is included in the following:

- Slash was collected within the Kootenai Development Company (KDC) property boundary during fuels management activities and stockpiled at the ACB staging area for use during the ACB treatability study as green/unseasoned fuel. Locations of the fuels management activities and the ACB staging area are shown on **Figure 2-1.**
- The slash was burned in a trailer-mount ACB unit. The burn operation consisted of the following three stages:
    - Startup phase: dry firewood sourced from outside of OU3 was used to start a fire in the ACB unit to establish a hot fire base.
    - Full operation phase: the green/unseasoned slash was added to the ACB unit every 15 to 45 minutes for approximately 4 hours.
    - Burn down phase: the slash was allowed to burn down without additional slash added to the ACB unit.
- A total of 16 perimeter air filter samples, with 8 high volume and 8 low volume samples, were collected during the burn operation.
- Collection of environmental and operational data, including meteorological conditions (wind speed, wind direction, air temperature, precipitation, and relative humidity), slash fuel size and moisture content, combustion temperature, ACB unit diesel fuel consumption, visual smoke opacity, and slash volume throughput.
- A 5-point composite ash sample was collected at the end of the ACB treatability study.

Details on field data and LAA analytical sample collection are documented in the Phase 1 TS Technical Report (Stantec, 2018b) and the 2017 FSSR (Stantec, 2018c).

2.3 2017 COVER TREATABILITY STUDY

2.3.1 Objectives

Several exposure scenarios were identified in the Site-wide Human Health Risk Assessment (HHRA) (EPA, 2015b; 2018) that have the potential to result in unacceptable human health risks from the inhalation of LAA during specific, vigorous disturbances of LAA-impacted media in the forested areas within OU3 (Phase 1 Area of the FS). Among these are exposures to commercial loggers and outdoor workers during activities that vigorously disturb soil/duff such as hooking and skidding of timber, site restoration after logging activities, slash pile building, holding crew during an understory burn, and performing wet and dry mop-up activities during and after a fire. One remediation technology being considered to reduce the release of airborne LAA during these vigorous disturbance activities is covering the impacted soil/duff in certain forested areas of OU3. A treatability study was performed in the summer of 2017 to evaluate the effectiveness of two cover materials, including augmented vegetation (e.g., hydroseeding) and biomass (e.g., masticated wood) materials, in reducing LAA releases during specific, vigorous soil/duff disturbances. Results of the cover treatability study support the screening and detailed analysis of components of the remedial alternatives of the OU3 FS.

2.3.2 Field Activities

A summary of cover treatability study activities is included in the following:

- Delineation of the test plot and sub-division of the test plot into sub-plots for different soil disturbance activities. The location and layout of the test plot are shown on **Figure 2-2**.
- Performing shallow disturbance of the sub-plots using a heavy-duty garden rake (performed by 3 field team members for a total of 45 minutes) and deep disturbance using a combi-tool (performed by 3 field team members for a total of 30 minutes) under different cover conditions:
    - no cover
    - augmented vegetative cover – a vegetative cover established through hydroseeding (a planting process that uses a slurry of seeds and masticated material without the addition of topsoil)
    - one-inch-thick biomass cover – a one-inch-thick cover of masticated wood material (vegetation that has been reduced in size by grinding, shredding, or chopping).
    - four-inch-thick biomass cover – a four-inch-thick cover of masticated wood material
- Collection of 144 ABS samples (72 high volume and 72 low volume) during the two different disturbances and under the four different cover conditions.
- Collection of environmental and operational data, including meteorological conditions (wind speed, wind direction, air temperature, precipitation, and relative humidity), soil type, soil moisture content, vegetation height, vegetation density, and biomass cover thickness.

Details on field data and LAA analytical sample collection are documented in the Phase 1 TS Technical Report (Stantec, 2018b) and the 2017 FSSR (Stantec, 2018c).

2.4 2018 WINTER HOOKING/SKIDDING ABS STUDY

2.4.1 Objectives

The study purpose was to evaluate whether winter conditions (e.g., snow cover and/or frozen ground) reduce the potential for entrainment of LAA in air from the forest floor during hooking/skidding activities relative to summer conditions (e.g., dry, dusty, exposed ground). To make this evaluation, the 2018 winter hooking/skidding ABS study was conducted at Area E (**Figure 2-3**), which was one of the areas with the highest LAA concentrations in the ABS samples during the 2016 hooking/skidding ABS study.

The specific objectives of the winter hooking/skidding study in Area E were to:

- Collect and analyze ABS air samples from Area E during the winter when snow cover and/or frozen ground conditions were present using the same collection and analysis methods from the 2016 ABS SAP/QAPP.
- Compare the new winter ABS mean air concentration to the 2016 ABS summer hooking/skidding mean air concentration from Area E to evaluate whether winter conditions reduced potential LAA inhalation exposure. This comparison implies the relative risk reduction for commercial loggers that would be achieved if a winter logging institutional control (i.e., restricting commercial logging to the site conditions that reflect the winter conditions evaluated in this study) were implemented. Results of the winter hooking/skidding ABS study will support the screening and detailed analysis of the remedial alternatives of the OU3 FS.

As stated in 2018 Winter ABS SAP/QAPP Addendum (Stantec, 2018a), for the purposes of data interpretation, and to be consistent with the data collected during the 2016 hooking/skidding ABS study, the pooled[1] PCME LAA air concentration was calculated across five ABS air filters. The pooled mean PCME LAA concentrations for the summer (2016) and winter (2018) hooking/skidding studies were compared to evaluate if hooking/skidding during the winter months (when snow cover conditions are present) reduced the release of airborne LAA from the forest floor during the hooking/skidding ABS activity. The ratio of the summer mean PCME LAA concentration to the winter mean PCME LAA concentration was calculated. A ratio less than or equal to one would indicate there was no reduction in air concentrations and a ratio greater than one would indicate a reduction occurred by a magnitude of the ratio value (i.e., a ratio of 2 would indicate a 2-fold reduction in airborne PCME LAA concentrations during the winter compared to the summer).

2.4.2 Field Activities

The 2018 winter hooking/skidding ABS study occurred between February 10 and 14, 2018 and was conducted by Stantec with oversight from CDM Smith. Work criteria for performance and field activities included:

- Confirming that atmospheric and ground conditions met the study criteria, including:
  - wind speed less than 20 miles per hour,
  - no active precipitation in the form of rain or snow,
  - ambient temperature at or below 32 degrees Fahrenheit (^{o}F), and
  - snow depth of at least 8 inches but no more than 3 feet, or settled snow depth of at least 2 inches and frozen ground via visual inspection.
- Felling a live tree of at least 8-inches diameter at breast height (dbh) for hooking/skidding in Area E.

[1] Calculation of the pooled LAA air concentration is illustrated by the following equation:
$C_{air,LAA} = \sum N_i / (\sum 1/S_i)$
where:
$C_{air,LAA}$ = pooled PCME LAA air concentration across multiple filters (s/cc)
N_i = number of PCME LAA structures observed for filter "i" (s)
S_i = analytical sensitivity for filter "i" (cc^{-1})

- Performing tree hooking/skidding activities along the same skid path as the 2016 hooking/skidding ABS activity while collecting personal air samples. The location and slope of the skid path are shown on **Figure 2-3**.

Pre-field tasks are described in detail in the 2018 Winter ABS SAP/QAPP Addendum (Stantec, 2018) and summarized below:

- Snow depths along the skid path were measured using a depth probe/measuring stick (or equivalent) to verify that the depths were within the accepted range. Snow depth was measured the week prior to the study and the day before the field team conducted the ABS sampling.
- Meteorological data were downloaded from the local NOAA station LBBM8 (located at 1263 MT Highway 37) the day before the study to document site conditions and verify study criteria including temperature (°F) (sampling criterion between 15 - 32°F), relative humidity (percent) (no sampling criterion), wind speed (miles per hour; mph) (sampling criterion ≤20 mph), and precipitation (inches) (sampling requires no precipitation in the form of rain or snow on the day of the study).
- On the day of the study within the study area, field personnel monitored temperature (°F), relative humidity, and wind speed using a hand-held instrument (i.e., Kestrel hand-held unit) during sampling.
- Snow water content was measured on the day of the study to evaluate the amount of water contained in the snowpack.
- One live tree [Douglas fir of at least 8-inches dbh] was felled using a chainsaw for use in the hooking/skidding ABS evaluation and was not de-limbed.

A closed-cab, track-mounted bulldozer was used for this investigation to drag the tree with a cable along the skid path. To replicate the sampling methods (hooking/skidding script) followed during the 2016 hooking/skidding ABS activities in Area E, the skidder operator wore two sampling pumps, a high flow pump and a low volume pump (i.e., each filter represents the same sample collection duration, but different total sample air volumes), attached such that the sample collection was in close proximity to the breathing zone. During the hooking/skidding activity, the operator exited the cab and attached a cable to the felled tree. Once the tree was attached with the cable, the operator re-entered the cab and skidded/dragged the hooked tree back and forth along approximately the same skid path within Area E that was used in 2016. After approximately 15 minutes of skidding, the operator exited the cab to unhook and then hook to the same tree and resumed the skidding activities back and forth along the skid path. The hooking/skidding ABS scenario was performed for a total of 2.5 hours in Area E. Additional field personnel were stationed at either end and in the middle of the skid path to measure snow depths, to document the conditions of the skid path and other observations each time the dozer passed by, and to collect the air filter samples from the skidder operator after each 30-minute sampling period. Both air sampling cassettes (one high volume and one low volume) were changed every 30 minutes throughout the 2.5-hour ABS event. Thus, 10 filters were collected for the 2.5 hour sampling period (i.e., five high volume filters and five low volume filters) for the skidder operator and five filters were analyzed.

All field activities were recorded in a project dedicated field logbook and sample information was recorded on an investigation-specific FSDS forms. Photos and videos were taken regularly during the study. In addition, global positioning system (GPS) points along the winter hooking/skidding path were collected to verify that ABS activities were conducted within approximately the same area as during the summer sampling event in Area E. Field documentation of the study, including FSDSs, COCs, and field notes, are included as **Attachment E**. A photographic log of the study is included as **Attachment F**.

3 SUMMARY OF 2017 GEOTECHNICAL AND HYDROGEOLOGICAL INVESTIGATION

This section summarizes the objectives and field activities for the 2017 geotechnical and hydrogeological investigation. The field studies were performed in accordance with the following document:

- Sampling and Analysis Plan / Quality Assurance Project Plan, Geotechnical and Hydrogeological Investigation – Libby Asbestos Superfund Site, Operable Unit 3 (Geotechnical SAP/QAPP; Stantec, 2017b)

Detailed data collection requirements and laboratory testing methods, where applicable, for the investigations were presented in the above document and are not repeated herein. A brief summary of the field investigation objectives and activities are presented below and will be provided in more detail in the forthcoming Geotechnical Investigation Data Report (Stantec, 2018d). Additional supporting information (including data collection tables) are included in the 2017 FSSR (Stantec, 2018c).

3.1 2017 GEOTECHNICAL AND HYDROGEOLOGICAL INVESTIGATION

3.1.1 Objectives

The geotechnical field investigation program was conducted to characterize the subsurface conditions in support of engineering analysis and evaluations of remedial alternatives of the KDID, WRPs, and CTP. Data from the 2017 field investigation program were collected to support the ongoing evaluation of the KDID dam safety modifications, including design of the new service spillway, as well as the concept development and evaluations as part of the CERCLA FS. The main scope items included in the 2017 geotechnical and hydrogeological field investigation and described in detail in the forthcoming Geotechnical Investigation Data Report (Stantec, 2018d) consist of the following:

- Site Reconnaissance
- Test Pit Excavation
- Sonic and Rotary Drilling
- In-situ Testing
- Installation of Instrumentation
- Geophysical Surveys
- Laboratory Testing
- Erosion and Infiltration Testing

3.1.2 Field Activities

3.1.2.1 Site Reconnaissance

Stantec performed limited reconnaissance while marking final borehole locations, prior to drilling. The area near the left abutment of the KDID and the WRPs were the primary reconnaissance areas. The goal was to locate bedrock outcrops near the KDID left abutment and identify general slope instability indicators, such as seeps and head scarps, near the WRPs.

3.1.2.2 Test Pit Excavation

The evaluation included the excavation of 35 test pits near the KDID, the WRPs, the CTP, and along potential stream diversions for the purpose of evaluating the subsurface geotechnical and geologic conditions and collecting soil samples for the identification of geotechnical properties. The test pits were excavated in accordance with the procedures outlined in the Geotechnical SAP/QAPP using a Caterpillar 320C excavator to depths of up to 18 feet below ground surface (bgs). Soil samples were logged by a Stantec field engineer for soil type according to the Unified Soil Classification System (USCS). A map showing the locations of the test pits is provided on **Figure 3-1**.

Approximately one to two soil samples were collected from each test pit at depths ranging from 1 to 17 feet bgs for geotechnical index testing. Generally, soil samples represented a 1 to 3-foot depth interval within the test pit. The goal was to obtain representative samples of each soil unit encountered in each area of the site. In the case where multiple soil units were encountered in one test pit, multiple samples were sometimes obtained. Samples were collected by hand from the test pit spoils laid out next to the excavation. Samples were placed in plastic bags, sealed inside of plastic 5-gallon plastic buckets, and sent under chain-of-custody control to Pioneer Technical Services for testing.

The geotechnical testing (and the corresponding American Society for Testing and Materials [ASTM] designation) and number of sample analyzed for each test are summarized below:

- Natural moisture content (ASTM D2216) 35 samples
- Particle size analysis – gradation (ASTM D6913) 33 samples
- Particle size with Hydrometer analysis – gradation (ASTM D422) 2 samples
- Atterberg limit (ASTM D4318) 29 samples
- Standard Proctor density (ASTM D698) 5 samples

3.1.2.3 Borehole Investigation

The purpose of the borehole investigation was to collect geotechnical, geological, and hydrogeological data that will inform input parameters for various stability, seepage, and geologic analytical models of the KDID, CTP, and WRPs. The borehole investigation included drilling 15 boreholes at 14 locations, collecting soil samples for geotechnical analyses, constructing piezometers and inclinometers in the boreholes, and conducting in-situ hydraulic conductivity testing.

Drilling was performed according to the procedures described in the Geotechnical SAP/QAPP by Cascade Drilling. Boreholes were advanced using either resonant sonic or mud and water rotary drilling methods.

Rock and soil samples were collected from each borehole. A continuous, approximately 6.5-inch diameter soil and rock sample was collected using the resonant sonic drilling method. Samples from the continuous core were selected by hand and placed in a baggie for laboratory testing. Soil samples were collected using the mud rotary drilling method and rock samples were collected using the water rotary drilling method. The 1.5-inch diameter Standard Penetration Test (SPT) sampler, the 2.5-inch diameter modified California Sampler, a thin-walled Shelby Tube sampler, and a Pitcher Tube sampler were used to collect soil samples between 6 and 18 inches long. A continuous, approximately 2.5-inch diameter rock core was collected in bedrock. Approximately 12-inch-long rock core samples were selected by hand for laboratory testing.

Sampling intervals were chosen to gain representative samples of each soil or rock unit encountered. The soil and rock samples collected from both drilling methods were evaluated and logged by a field geologist/engineer for soil type according to ASTM D2487 Standard Practice for Classification of Soils for Engineering Purposes; bedrock samples were evaluated and logged according to the criteria developed by the International Society of Rock Mechanics. Additionally, all core and soil samples were photographed at a consistent scale for the full length of the borehole. Photographs of recovered core will be included in the forthcoming 2017 Geotechnical Investigation Summary Report. A map showing the locations of the boreholes is provided on **Figure 3-2**.

Soil samples were collected for geotechnical analyses using different sampling methods as required by the analyses. The quantity of soil samples and sampling methods include:

- 77 SPTs with split spoon samplers
- 23 Modified California tube samples
- 66 Shelby Tube / Pitcher Tube samples

The geotechnical testing and number of sample analyzed for each test are summarized below:

- Natural Moisture Content (ASTM D2216) 78 samples
- Particle Size Analysis – Gradation (ASTM D6913) 55 samples
- Particle Size Analysis – Gradation with Hydrometer (ASTM D422) 25 samples
- Atterberg Limit (ASTM D4318) 39 samples
- Specific Gravity (ASTM D854) 19 samples
- Moisture Content and Dry Density (ASTM D2216 & 2937) 10 samples
- Direct Shear (ASTM D3080) 5 samples
- Triaxial Shear - Unconsolidated, Undrained (ASTM D2850) 2 samples
- Consolidation Test (ASTM D2435) 2 samples
- Compressive Strength of intact rock core specimens (ASTM D7012) 14 samples
- Corrosion Testing (pH, sulfate, chloride, resistivity, sulfides) 2 samples

In-situ falling and constant head tests were conducted at the CTP [Borehole-15 (BH-15)], WRPs (BH-10, BH-11 and BH-12), and KDID (BH-19) to estimate the range of horizontal hydraulic conductivity for the materials encountered. The intent was to estimate hydraulic conductivities for multiple units and locations on-site in order to improve understanding of material properties. The hydraulic conductivity tests were performed in accordance with the procedures outlined in MWH SOP No. 28 Aquifer Testing.

Polyvinyl chloride (PVC) standpipe piezometers were installed in nine boreholes within the WRPs (BH-10, BH-11 and BH-12), CTP (BH-15), and KDID (S-03, S-04, S-06, BH-17, and BH-19) in order to gain information on the groundwater phreatic surface in the vicinity of each area. The phreatic surface estimate is used for modeling slope stability of the WRPs, CTP and KDID. A vibrating wire piezometer was fully grouted below the screened interval of the standpipe piezometer in borehole BH-11 to investigate potential upward gradients near the lower portion of the West Waste Rock Pile. A vibrating wire piezometer was installed within the screened zone of BH-19 for remote sensing of pore pressure and water level in order to monitor changes in the phreatic surface upstream of the KDID embankment and potential impacts on KDID drain operation. Inclinometers were installed in each of the boreholes within the WRPs (BH-10, BH-11 and BH-12) to measure slope movement over time. Each location is strategic in monitoring potential slope movement of the West Waste Rock Pile. Piezometer and inclinometer specifications were recorded on the piezometer completion form and the slotted inclinometer with vibrating wire piezometer completion forms.

3.1.2.4 Geophysical Testing Investigation

Geophysical testing was performed by Olson Engineering, Inc. at the KDID embankment, impoundment and spillway areas. Several geophysical methods were used to gain a variety of subsurface information including, depth to bedrock, seismic properties of soil and rock and the possible presence of voids including:

- Seismic refraction
- Multi-channel analysis of surface waves (MASW)
- Resistivity testing

Two less commonly used geophysical methods were used to investigate the location of buried decant pipes and towers at the KDID:

- Electromagnetic
- Misse a la Masse (MALM) testing

3.1.2.5 Erosion Evaluation and Surface Hydraulic Conductivity Testing Investigation

The erosion test plots investigation was performed to identify and classify erosion features observed on the WRPs, according to the methods proposed in the Geotechnical SAP/QAPP. The class of erosion was estimated based on the Bureau of Land Management (BLM) Erosion Condition Classification System (Clark, 1980). Following the erosion evaluation, erosion test plots representative of the existing conditions were delineated. The test plots, approximately 30 feet by 30 feet, were rated with a Soil Surface Factor (SSF) based on the Erosion Condition Classification System. Photographs were taken of the general condition of each plot and soil conditions. Photographs and a summary of erosion classifications will be included in the forthcoming Geotechnical Investigation Summary Report.

A Guelph Permeameter was used to estimate the saturated hydraulic conductivity of the near surface in-situ waste rock material at multiple locations on the WRPs. Tests were performed in hand auger borings to a depth of six to twelve inches bgs. Guelph Permeameter tests were performed according to the procedures outlined in the Guelph Permeameter Operating Instructions.

4 RESULTS

This section presents the sampling results for the 2017 and 2018 RI-related field activities, and where available, the geotechnical and hydrogeological investigations. Detailed data evaluations of the 2017 treatability studies are included in the Phase 1 TS Technical Report (Stantec, 2018b), with an additional data summary as well as data collection documentation provided in the 2017 FSSR (Stantec, 2018c). The detailed data evaluation of the 2018 winter hooking/skidding ABS study is included and discussed below with data collection documentation attached herein (see **Attachments E** and **F**). Details of the geotechnical and hydrogeological investigations data collection results are briefly summarized below and will be presented in detail in the forthcoming Geotechnical Investigation Data Report (Stantec, 2018d). **Attachment G** contains the complete sets of analytical results for the treatability studies and winter hooking/skidding ABS discussed below.

The data summary tables included in this RI addendum include PCME LAA results for all air samples and both PCME and total LAA results for the ash samples. PCME LAA results are included in the discussions below for ash because the available toxicity values used for human health risk assessment are based on studies using Phase Contrast Microscopy (PCM) data. Additional discussion regarding LAA analytical methods is included in Section 3.5.1 of the OU3 RI Report (MWH, 2016).

4.1 2017 ACB TREATABILITY STUDY

4.1.1 Field Data Results

Field data including meteorological conditions, slash size distribution and moisture contents, and visual smoke opacity are included as Panels A through C, respectively, in **Table 2-3**. The meteorological data (Panel A of **Table 2-3**) were collected prior to, and during, the ACB treatability study to confirm meteorological conditions met the study criteria (no rainfall and wind speed less than 20 miles per hour).The meteorological data confirmed that the ACB treatability study was conducted under favorable conditions. The slash size distribution and moisture content data (Panel B of **Table 2-3**) indicate that the majority of the slash materials had a diameter of 6 inches or less and that the slash had a moisture content above 30% and remained unseasoned for the ACB treatability study (vegetation with a moisture content of less than 20 – 30% is considered seasoned fuel). The visual smoke opacity results (Panel C of **Table 2-3**) during the startup phase percent opacity average was below the study-specific decision threshold of 35%. The results (Panel C of **Table 2-3**) during the full operation phase percent opacity average also was below the study-specific decision threshold of 10% which meets the standards set forth in EPA New Source Performance Standards (NSPS) regulations for ACBs.

Field data that also were collected but not shown on **Table 2-3** include combustion temperature, ACB unit diesel fuel consumption, and slash volume throughput. The combustion temperature fluctuated between 900ºF and 1,100ºF during the startup phase, and the first half of the full operation phase due to the frequent loading of new slash materials. The temperature increased to between 1,400ºF and 1,700ºF in the second half of the full operation phase when the fuel loading rate was reduced due to embers escaping the burn unit. The ACB unit diesel fuel consumption rate was estimated to be approximately 0.6 gallons per hour based on fuel gauge readings taken before the startup and after the burn down, and the duration of the burn operation. Based on the duration of the full operation and dimension measurements of the slash pile taken before and after the burn operation, the slash volume throughput achieved during the ACB treatability study was approximately 6 to 8 cubic yards per hour (CY/hr), which was above the study-specific decision threshold of 5 CY/hr.

A more detailed discussion of these field data is included in the Phase 1 TS Technical Report (Stantec, 2018b).

4.1.2 Analytical Data Results

A summary of LAA analytical results for the perimeter air samples is included as **Table 2-4**; the complete set of analytical data is included in **Attachment G**. PCME LAA structures were observed in two of the eight perimeter air samples; the PCME LAA concentrations in all air samples were below the study-specific decision threshold of 0.1 structure/cubic centimeter (s/cc) which is the Occupational Safety and Health Administration (OSHA) Permissible Exposure Limit (PEL) for asbestos.

A summary of LAA analytical results for the ash sample is included as **Table 2-5**; the complete set of analytical data is included in **Attachment G**. The average total LAA concentration in ash was 16 million structures per gram (Ms/g), or 0.002% by mass (Panels A and B of **Table 2-5**), which is below the study-specific decision threshold of 1% by mass. PCME LAA structures were not detected in the ash sample (Panel C of **Table 2-5**).

A more detailed discussion of the LAA results is included in the Phase 1 TS Technical Report (Stantec, 2018).

4.2 2017 COVER TREATABILITY STUDY

4.2.1 Field Data Results

Field data including percent composition of soil, soil moisture content, and vegetation cover characteristics are included as Panels A through B, respectively, in **Table 2-6**. The percent composition of soil data (Panel A of **Table 2-6**) indicates that the soil of the cover treatability study test plot is primarily coarse grain materials with no clay observed. The soil moisture content measurements (Panel B of **Table 2-6**) confirmed that the soil moisture did not exceed the 20 percent threshold in order for the cover treatability study to proceed. The vegetative cover characteristics panel (Panel C of **Table 2-6**) shows that there are on average 11 plants per square foot on the test plot and that the average plant height is 11 inches.

Field data that were also collected but not shown on **Table 2-6** include meteorological conditions and biomass cover size and thickness. The meteorological data were collected prior to the start of the cover treatability study to confirm pre-study meteorological conditions met the study criteria, including rainfall less than ¼ inch in the 36 hours leading up to the study and wind speed less than 20 miles per hour. Biomass cover size and thickness were measured to document the biomass cover characteristics. The size of the masticated wood pieces that composed the biomass cover was estimated to be approximately 1 – 5 inches long, 1/4 - 1/2 inch wide, and 1/8 inch thick. In addition, larger slash pieces of 2 – 4 inches in diameter and 1 – 5 feet long were added to approximate the masticated biomass that could result from tree removal or fuels management activities in the forested areas of OU3.

A more detailed discussion of these field data is included in the Phase 1 TS Technical Report (Stantec, 2018b).

4.2.2 Analytical Data Results

A summary of the PCME LAA analytical results of the cover treatability study are included as **Table 2-7** and the complete set of analytical data is included in **Attachment G.**

The mean PCME LAA concentration for each disturbance scenario and cover type is summarized in Panel A and illustrated in Panel B of **Table 2-8**. The percent reduction of mean PCME LAA concentration of each cover scenario relative to the pre-cover condition is presented in Panel A of **Table 2-8**. The shallow disturbance scenarios show contradictory results as not all cover types yielded reduction in LAA concentration. For deep disturbance scenarios, all three covers types yielded positive results with a 52 – 60% reduction in LAA concentration compared to pre-cover condition. When the data are averaged across the shallow and deep disturbance scenarios, all covers show reduced LAA air concentrations compared to pre-cover conditions, and the reductions vary by cover type. The post-cover to pre-cover ratios were 0.93 for the vegetative cover (a reduction of 7%), 0.70 for the 1-inch biomass cover (a reduction of 30%), and 0.50 for the 4-inch biomass cover (a reduction of 50%).

A more detailed discussion of the LAA results is included in the Phase 1 TS Technical Report (Stantec, 2018).

4.3 2018 WINTER HOOKING/SKIDDING ABS

4.3.1 Field Data Results

Field data including meteorological conditions and snow depth measurements are included as Panels A and B, respectively, in **Table 2-9**. The meteorological data collected during the ABS activities confirmed that the study was conducted under atmospheric conditions that met the study criteria, which included wind speed less than 20 miles per hour, no active precipitation in the form of rain or snow, and ambient temperature at or below 32ºF. The snow depth also met the study criterion of a minimum of 8-inches[2] on average across the study area where hooking/skidding would be performed. Snow water content measurement with 465 milliliter (mL) of snow yielded 160 mL of water when the snow was allowed to melt. The complete set of 2018 winter hooking/skidding ABS study field data and the coordinates of the ABS activity locations are included as **Attachment H**. Field documentation of the study, including FSDSs, COCs, and field notes, are included as **Attachment E**. A photographic log of the study is included as **Attachment F**.

4.3.2 Analytical Data Results

The results for the ABS samples collected from the 2018 winter hooking/skidding activities are summarized on **Table 2-10** and the complete set of analytical data is included in **Attachment G**. The results from the 2016 hooking/skidding ABS activities conducted in the summer also are included on **Table 2-10** for comparison. No PCME LAA structures were found in three of the five 2018 winter ABS samples; one structure each was identified in the remaining two samples. The pooled mean PCME LAA concentration calculated across the five 2018 winter ABS air filters was 0.0015 s/cc of air sampled. The ratio of winter 2018 ABS LAA air concentration to summer 2016 ABS LAA air concentration is 0.039, which represents a 26-fold reduction, or a 96% reduction, in

[2] Snow depth measurements were taken a few days before the study commenced. Depths ranged from 5 to 11-inches along the skid path yielding an average snow depth of approximately 8-inches. In addition, the soil was observed to be frozen and the ambient air temperature was recorded at 17°F.

winter 2018 ABS PCME LAA air concentration relative to the summer 2016 ABS PCME LAA air concentration.

4.3.3 Field and Laboratory QC Results

Field QC Samples:

- **Lot Blanks** – Two air filter lot blanks were analyzed by TEM and no asbestos structures were observed. Based on the lot blank results, the air filters used during the field sample collection did not contain asbestos.
- **Field Blanks** – One field blank was analyzed by TEM and no asbestos structures were observed. Based on the field blank results, the potential contamination introduced during sample collection, shipping and handling, or analysis is not of concern.
- **Field Duplicates** – No field duplicates were collected.

Lab QC Samples:

Laboratory QC samples will be evaluated in a forthcoming Annual QA/QC Summary Report prepared by the QATS contractor, APTIM.

4.4 2017 GEOTECHNICAL AND HYDROGEOLOGICAL INVESTIGATION

A brief summary of the geotechnical properties for the subsurface units are presented below and are organized by material type. A more detailed discussion of these results will be provided in the forthcoming Geotechnical Investigation Data Report (Stantec, 2018d) including a description for each of the primary subsurface units encountered at the Site, a summary of the observed material properties, and the results of the field investigation and testing.

4.4.1 Field Data Results

4.4.1.1 Fine Tailings

Fine tailings are located at the KDID impoundment and were encountered in one boring (BH-19) and one test pit (GT-57). The fine tailings were overlain with about one foot of organic material and vegetation. The fine tailings material consists predominantly of interbedded fine sands and silty sands (SP, SM) and moderate to high plasticity silts (ML or MH) that are often laminated or very thinly-bedded. These soils range in density and consistency from loose/very soft to medium dense/stiff.

4.4.1.2 Coarse Tailings at CTP

Boring S-02 encountered a few feet of coarse tailing and only near surface. Boring BH-15 (the only boring drilled on the CTP) encountered coarse tailings that predominantly consisted of well graded to poorly graded sands and silty sands (SP, SW, SM) with a fine fraction that ranged from 3 to 21%. The coarse tailings were typically described as loose to very dense, moist, and dark greenish brown to medium brown.

4.4.1.3 Waste Rock

Waste rock was observed in three borings (BH-10 through BH-12) on the west WRP and in four test pits (GT-47 through GT-50) located on the west WRP, central WRP and east WRP. The waste rock material varies from light brown, grey, to dark greenish brown and was found to consist predominantly of silty or clayey sands with gravel, and well-graded sand with silt and gravel (SM, SC, SW-SM). The density was generally observed to increase with depth with the upper 30 feet bgs being loose to medium dense, between 30 and 100 feet bgs medium dense to very dense and below 100 feet bgs it is dense to very dense. The fines fraction of the waste rock ranges from 8 to 44% and is composed primarily of low plasticity silts (ML) based on laboratory testing. The waste rock material includes oversize material of cobbles and boulders, which were not included and represented in the tested samples. Cobbles and boulders up to approximately 24 inches in diameter were encountered in sonic drilling core.

4.4.1.4 Alluvium

Alluvium was observed in three borings (S-01, BH-17A, and BH-19) and in four test pits (GT-30, GT-46, GT-61, and GT-62). The alluvium encountered is typically described as a bedded, well-graded gravel or sand with varying amounts of silt and with occasional cobbles and boulders (GW, GM, GW-GM, SW-SM, SP-SM, SC-SM).

4.4.1.5 Glacial Deposits

Glacial deposits were observed in nine borings (BH-10 through BH-12, BH-15, BH-17A, BH-17B, S-01, S-06, and S-08) and in thirteen test pits (GT-28, GT-29, GT-32, GT-35 through GT-38, GT-40, GT-41, GT-45, and GT-58 through GT-60). “Glacial deposits” or “Undifferentiated glacial deposits” are terms used to describe a collection of several subunits with widely varying composition that have been deposited directly by glaciers themselves (till or moraine) or by glacial melt water (glacial outwash/glaciofluvial, or glacial lake/glaciolacustrine). Glacial till and moraine deposits are typically present along the valley side slopes, and accumulated as ablation till, basal till, and moraines (lateral, end, and recessional) during the many advances and retreats of glaciers within the region. Glacial outwash (also glaciofluvial) deposits (Qgf) accumulated in the Rainy Creek valley as the result of regional glacial activity.

4.4.1.6 Weathered Bedrock

Weathered bedrock was observed in the borings at the spillway, WWRP and CTP and in a large portion of test pits throughout the Site (S-01 through S-08, BH-10 through 12 and BH-15). Where encountered, this rock unit was comprised of completely weathered (W6), extremely weak (R0), pyroxenite and syenite bedrock. The weathered rock is between 5 and 34 feet thick at the drilling and test pits locations. The highly weathered portions of the pyroxenite and syenite bedrock have the characteristics of a soil. If classified in accordance with the Unified Soil Classification System, the completely weathered rock classifies as medium dense to dense, poorly-graded or well-graded sand with silt and gravel, silty sand, or as well-graded gravel with silt and sand (SW-SM, SP-SM, GW-GM).

4.4.1.7 Unweathered Bedrock

The basement rock units encountered at the site consist of three igneous rock types, pyroxenite, diorite, and syenite. The 2017 explorations encountered pyroxenite underlying the existing and proposed KDID spillways, the CTP, and the northern-most portion of the WWRP. Diorite was encountered below the southern portion of the WWRP, below the outlet of the principal spillway at S-01, and in intrusive layers within the pyroxenite. Syenite was observed underlying overburden soils near the upper portion of the WWRP at the location of BH-10.

5 CONCLUSIONS

5.1 2017 ACB TREATABILITY STUDY

The following conclusions resulted from the ACB treatability study:

1. Emissions: Average PCME LAA concentrations in perimeter air near the ACB were below the study-specific threshold of 0.1 s/cc, which is the OSHA PEL for asbestos. In addition, visual smoke emissions from the ACB during the startup and full operation phases were below their respective study-specific thresholds of 35% and 10% opacity, which meets the standards set forth in EPA NSPS regulations for ACBs.
2. Total LAA Concentration in Ash: Average total LAA concentration in the 5-point composited ACB ash sample is below the study-specific threshold of 1% by mass.
3. Material Seasoning: When unseasoned slash is burned in the ACB, the average ACB smoke emission during the full operation stage was lower than the study-specific threshold of 10% opacity, which is based on the EPA NSPS regulations for ACBs. In addition, the ACB slash volume throughput is above the study-specific threshold of 5 CY/hr. Therefore, the use of unseasoned slash does not negatively affect ACB emissions and throughput.
4. The ACB treatability study demonstrated that burning green/unseasoned slash was implementable at the site.

5.2 2017 COVER TREATABILITY STUDY

The following conclusions resulted from the cover treatability study:

1. Covers reduced LAA concentrations in air in 4 of the 6 cover disturbance scenarios tested, with reductions in LAA concentrations in air ranging from 44% to 60% compared to pre-cover disturbance scenarios.
2. There were contradictory results for 2 of the 6 cover disturbance scenarios tested, likely reflecting the variability associated with ABS to measure PCME LAA concentrations in air when LAA-containing media when heterogeneous concentrations of LAA are disturbed. These contradictory results add a level of uncertainty to the use of the non-contradictory results to quantify the effectiveness of covers. However, it is reasonable to conclude that the contradictory results were likely caused by study variability and do not necessarily conflict with the overall premise that covers provide some level of effectiveness.
3. When the shallow and deep disturbance data were combined and averaged to address study variability, all cover types were effective. The calculated post-cover to pre-cover ratios were 0.93 for the vegetative cover (a reduction of 7%), 0.70 for the 1-inch biomass cover (a reduction of 30%), and 0.50 for the 4-inch biomass cover (a reduction of 50%).

5.3 2018 WINTER HOOKING/SKIDDING ABS

The purpose of the 2018 winter hooking/skidding ABS study was to compare the LAA air concentration that resulted from hooking/skidding ABS conducted on dry, bare ground during worst-case conditions in the summer months versus on frozen, snow-covered ground in winter conditions. The ratio of winter 2018 ABS LAA air concentration to summer 2016 ABS LAA air concentration was 0.039. Based on these results, it can be assumed that hooking/skidding during winter conditions reduces LAA concentrations in air by a factor of approximately 26 (or 96% reduction). This result indicates that restriction of commercial logging using hooking/skidding during the winter months as an institutional control could be effective in reducing commercial loggers' exposure to LAA liberated during logging operations.

5.4 2017 GEOTECHNICAL AND HYDROGEOLOGICAL INVESTIGATION

Data from the 2017 geotechnical investigation report will be used to develop input parameters for future analyses for the KDID, CTP and WRPs. Analyses include a seismic hazards assessment, multiple stability and seepage analyses, and erosion evaluations. Analyses and evaluations are planned to be used in support of the development of multiple design concepts.

6 REFERENCES

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Stantec, 2018d. Geotechnical Investigation Data Report – Libby Asbestos Superfund Site, Operable Unit 3. Libby, Montana. *In progress.*

TABLES

Table 2-1: Summary of LAA-related Field Studies Samples Collected and Analyzed in 2017/2018 for OU3

Phase	Description	Completed In Year	Total Number of Samples [a]	ABS Air	Perimeter Air	ACB Ash
Phase 1 TS - ACB	Phase 1 ACB Treatability Study	2017	**9**	0	8	1
Phase 1 TS - Cover	Phase 1 Cover Treatability Study	2017	**72**	72	0	0
ABS-2018	Winter Logging Hooking/Skidding	2018	**5**	5	0	0
		Total Asbestos Samples	**86**	**77**	**8**	**1**

NOTES:

[a] Excludes field and laboratory quality control samples/analyses

ABS = Activity Based Sampling

LAA = Libby amphibole asbestos

PHASE	PHASE NAME
Phase 1 TS - ACB	Phase 1 Air Curtain Burner Treatability Study
Phase 1 TS - Cover	Phase 1 Cover Treatability Study
ABS-2018	2018 Winter Hooking/Skidding ABS Study

Table 2-2: LAA-related Field Studies Station Descriptions and Sampling Phase/Event Performed in 2017/2018 for OU3

Media	Station ID	Station Description	LAASample Collection and Analysis by Phase / Event		
			Phase 1 TS - ACB	Phase 1 TS - Cover	ABS-2018
Ash	**ACB Unit**	ACB treatability study burn unit	X		
Perimeter Air	**ACB South**	ACB treatability study perimeter sampling point - south of ACB burn unit	X		
Perimeter Air	**ACB East**	ACB treatability study perimeter sampling point - east of ACB burn unit	X		
Perimeter Air	**ACB North**	ACB treatability study perimeter sampling point - north of ACB burn unit	X		
Perimeter Air	**ACB West**	ACB treatability study perimeter sampling point - west of ACB burn unit	X		
ABS Air	**SP-1S**	Cover treatability study ABS point - center point of shallow disturbance section of sub-plot 1		X	
ABS Air	**SP-1D**	Cover treatability study ABS point - center point of deep disturbance section of sub-plot 1		X	
ABS Air	**SP-2S**	Cover treatability study ABS point - center point of shallow disturbance section of sub-plot 2		X	
ABS Air	**SP-2D**	Cover treatability study ABS point - center point of deep disturbance section of sub-plot 2		X	
ABS Air	**SP-3S**	Cover treatability study ABS point - center point of shallow disturbance section of sub-plot 3		X	
ABS Air	**SP-3D**	Cover treatability study ABS point - center point of deep disturbance section of sub-plot 3		X	
ABS Air	**Area E**	Winter Hooking/skidding ABS sampling area located intermediate to and upwind from the former mine area			X

NOTES:

ABS = Activity Based Sampling
ACB = Air Curtain Burner
ID = identificatin
LAA = Libby amphibole asbestos

PHASE	PHASE NAME
Phase 1 TS - ACB	Phase 1 Air Curtain Burner Treatability Study
Phase 1 TS - Cover	Phase 1 Cover Treatability Study
ABS-2018	2018 Winter Hooking/Skidding ABS Study

Table 2-3: ACB Treatability Study Summary of Field Data Results

Panel A: Meteorological Conditions

Weather Parameter	Measurement from NOAA Station LBBM8	Measurement from a Pocket Weather Meter
Wind Direction	south-southeast to west	not measured
Wind Speed	2 – 6 mph	1 – 6 mph (occasional gusts up to 12 mph)
Air Temperature	72 – 80ºF	64 – 80ºF
Precipitation	0 inches	not measured
Relative Humidity	15 – 39%	24 – 54%

Notes:

ºF - degree Fahrenheit

% - percent

mph - miles per hour

Meteorological data measured during the startup, and full operation, and burn down phases of the ACB treatability study.

Panel B: Slash Size Distribution and Moisture Contents

Size in Diameter	Slash Pile Composition[a]	Average Moisture Content[b] (from previously cut surfaces)	Average Moisture Content[b] (from freshly cut surfaces)
Up to 3 inches	~ 45% by volume	30%	42%
4 – 6 inches	~ 35% by volume	44%	53%
7 – 9 inches	~ 15% by volume	36%	53%
10 inches and greater	~ 5% by volume	38%	53%

Notes:

[a]Slash pile composition estimated based on field volumetric measurements.

[b]The measurement range of the moisture meter is 0 – 53%. The moisture meter is factory calibrated to approximate the mass of moisture content relative to the mass of wood.

Panel C: Summary of Percent Opacity Averages

Burn Phase	6-Minute Interval Observation	Observation Interval Percent Opacity Average	Burn Phase Percent Opacity Average
Start-up	1	7%	6%
	2	5%	
Full Operation	3[a]	5%	6%
	4	5%	
	5	9%	
	6	5%	
	7	6%	
	8	8%	
	9	5%	
	10	5%	
Burn down	11	5%	5%
	12	5%	
	13	6%	

Notes:

Calculated opacity averages were rounded to the nearest integer.

[a]The 3rd 6-minute interval observation occurred during the transition from the startup phase to the full operation phase. Since the majority of the readings of this interval were recorded during the full operation phase, the average of this observation interval was reported under the full operation phase.

Table 2-4: ACB Treatability Study Summary of Analytical Data Results for Perimeter Air Samples

Sample Location	Sample Activity	Index ID*		Sample Date	Sample Air Volume (L)	Sample Duration (min)	Preparation Method	GOs Examined	Sensitivity (cc^{-1})	PCME LAA	
		HV	LV							N Structures	Conc. (s/cc)
ACB South	Startup & Full Operation	AC-00002	AC-00001	6/21/2017	542	180	Direct	4	1.7E-02	0	0
	Full Operation & Burn Down	AC-00011	AC-00010	6/21/2017	540	180	Direct	4	1.4E-02	0	0
ACB East	Startup & Full Operation	AC-00004	AC-00003	6/21/2017	551	180	Direct	4	1.7E-02	0	0
	Full Operation & Burn Down	AC-00013	AC-00012	6/21/2017	531	180	Direct	4	1.4E-02	1	1.4E-02
ACB North	Startup & Full Operation	AC-00006	AC-00005	6/21/2017	531	180	Direct	4	1.8E-02	0	0
	Full Operation & Burn Down	AC-00015	AC-00014	6/21/2017	540	180	Direct	4	1.4E-02	1	1.4E-02
ACB West	Startup & Full Operation	AC-00008	AC-00007	6/21/2017	540	180	Direct	4	1.7E-02	0	0
	Full Operation & Burn Down	AC-00017	AC-00016	6/21/2017	536	180	Direct	4	1.4E-02	0	0

Notes:

Filters were prepared and analyzed in basic accordance with TEM ISO 10312:1995(E) (ISO 1995), with all applicable Libby site-specific laboratory modifications.

*Filters were analyzed (shaded Index IDs)

ACB = air curtain burner

cc^{-1} = per cubic centimeter of air

Conc. = concentration

GO = grid opening

HV = high volume

ID = identification

ISO = International Organization for Standardization

L = liter

LAA = Libby Amphibole Asbestos

LV = low volume

min = minute

N = number

PCME = phase contrast microscopy - equivalent

s/cc = structures per cubic centimeter

TEM = transmission electron microscopy

Table 2-5: ACB Treatability Study Summary of Analytical Data Results for the Ash Sample

Panel A: Total LAA Results (as structures per gram)

Index ID	Sample Date	Replicate 1			Replicate 2			Replicate 3			Mean Conc. (Ms/g)
		Sensitivity (g^{-1})	N Structures	Conc. (Ms/g)	Sensitivity (g^{-1})	N Structures	Conc. (Ms/g)	Sensitivity (g^{-1})	N Structures	Conc. (Ms/g)	
AC-00019	6/29/2017	5.2E+06	3	16	5.2E+06	3	16	5.2E+06	3	16	16

Panel B: Total LAA Results (as mass percent)

Index ID	Sample Date	Pooled Across Replicates			
		Sensitivity (g^{-1})	Total N Structures	Total Structure Mass (g)	Conc. (mass percent)
AC-00019	6/29/2017	1.7E+06	9	8.7E-12	0.002%

Panel C: PCME LAA Results (as structures per gram)

Index ID	Sample Date	Replicate 1			Replicate 2			Replicate 3			Mean Conc. (Ms/g)
		Sensitivity (g^{-1})	N Structures	Conc. (Ms/g)	Sensitivity (g^{-1})	N Structures	Conc. (Ms/g)	Sensitivity (g^{-1})	N Structures	Conc. (Ms/g)	
AC-00019	6/29/2017	5.2E+06	0	0	5.2E+06	0	0	5.2E+06	0	0	0

Notes:

Filters were prepared and analyzed in basic accordance with TEM ISO 10312:1995(E) (ISO 1995), with all applicable Libby site-specific laboratory modifications.

Structure mass was calculated assuming a rectangular prism and a density of 3.1 g/cm^3.

Conc. = concentration

g^{-1} = per gram

ID = identification

ISO = International Organization for Standardization

LAA = Libby Amphibole Asbestos

Ms/g = million structures per gram

N = number

PCME = phase contrast microscopy, equivalent

TEM = transmission electron microscopy

Table 2-6: Cover Treatability Study Summary of Field Data Results

Panel A: Percent Composition of Soil

Sub-plot	USCS Group Symbol	Gravel	Sand	Silt	Clay
1S	SM	0 – 20%	40 – 60%	20 – 40%	0%
1D	SM	0 – 20%	40 – 60%	20 – 40%	0%
2S	SW-SM	0 – 20%	40 – 60%	20 – 40%	0%
2D	SW-SM	0 – 20%	40 – 60%	20 – 40%	0%
3S	SW-SM	20 – 40%	40 – 60%	0 – 20%	0%
3D	GM-GW	40 – 60%	20 – 40%	0 – 20%	0%

Notes:

% - percent

Panel B: Soil Moisture Content

Soil Cover Condition	Soil Moisture Content (Percent [%] by Volume)	
	At Soil Surface	3 inches Below Soil Surface
Pre-Cover (bare soil)	2%	9%
Post-Cover with Vegetation	3%	11%
Post-Cover with 1-inch Biomass	4%	16%
Post-Cover with 4-inch Biomass	5%	14%

Notes:

% - percent

Panel C: Vegetation Cover Characteristics

Characteristic	Range	Average
Density (plants/ft^2)	4.8 - 13.7	11
Height (inches)	0[a] - 28.5	11.3

Notes:

The quadrat locations for measuring plant height and density were randomly selected based on the methodology outlined in the "Sampling Vegetation Attributes" interagency technical reference, rather than being placed systematically throughout the test plot. The range and average of the density and height metrics were reported for the entire test plot rather than for individual sub-plots.

[a]plant height of 0 inches indicates bare soil.

ft^2= square feet

Table 2-7: Cover Treatability Study Summary of Analytical Data Results for ABS Air Samples

Scenario	ABS Type*	Sub-plot	Filter	Sample Date	Index ID*		Filter Analyzed?	Sample Air Volume (L)	Preparation Method	GOs Examined	PCME LAA			Pooled PCME LAA		
					HV	LV					Sensitivity (cc^{-1})	N Structures	Conc. (s/cc)	Sensitivity (cc^{-1})	N Structures	Conc. (s/cc)
Soil Pre-Cover	Shallow Disturbance ABS	Sub-plot 1	1	9/23/2017	CV-00038	CV-00039	CV-00038	60	Direct	46	0.011	4	0.043			
			2	9/23/2017	CV-00040	CV-00041	CV-00040	60	Direct	46	0.011	1	0.011	0.0036	6	0.022
			3	9/23/2017	CV-00042	CV-00043	CV-00042	60	Direct	46	0.011	1	0.011			
		Sub-plot 2	1	9/23/2017	CV-00044	CV-00045	CV-00044	60	Direct	46	0.011	4	0.043			
			2	9/23/2017	CV-00046	CV-00047	CV-00046	60	Direct	46	0.011	5	0.054	0.0036	10	0.036
			3	9/23/2017	CV-00048	CV-00049	CV-00048	60	Direct	46	0.011	1	0.011			
		Sub-plot 3	1	9/23/2017	CV-00050	CV-00051	CV-00050	60	Direct	46	0.011	5	0.054			
			2	9/23/2017	CV-00052	CV-00053	CV-00052	60	Direct	46	0.011	3	0.032	0.0036	8	0.029
			3	9/23/2017	CV-00054	CV-00055	CV-00054	60	Direct	46	0.011	0	0			
	Deep Disturbance ABS	Sub-plot 1	1	9/23/2017	CV-00056	CV-00057	CV-00056	40	Direct	68	0.011	3	0.033			
			2	9/23/2017	CV-00058	CV-00059	CV-00058	40	Direct	88	0.011	5	0.053	0.0036	16	0.058
			3	9/23/2017	CV-00060	CV-00061	CV-00060	40	Direct	85	0.011	8	0.088			
		Sub-plot 2	1	9/23/2017	CV-00062	CV-00063	CV-00062	40	Direct	85	0.011	15	0.16			
			2	9/23/2017	CV-00064	CV-00065	CV-00064	40	Direct	87	0.011	10	0.11	0.0036	40	0.14
			3	9/23/2017	CV-00066	CV-00067	CV-00066	40	Direct	87	0.011	15	0.16			
		Sub-plot 3	1	9/23/2017	CV-00068	CV-00069	CV-00068	40	Direct	68	0.011	2	0.022			
			2	9/23/2017	CV-00071	CV-00070	CV-00071	40	Direct	68	0.011	0	0	0.0037	10	0.037
			3	9/23/2017	CV-00072	CV-00073	CV-00072	40	Direct	68	0.011	8	0.088			
Vegetative Cover	Shallow Disturbance ABS	Sub-plot 1	1	9/22/2017	CV-00002	CV-00003	CV-00002	60	Direct	23	0.022	0	0			
			2	9/22/2017	CV-00004	CV-00005	CV-00004	60	Direct	23	0.022	6	0.13	0.0073	6	0.044
			3	9/22/2017	CV-00006	CV-00007	CV-00006	60	Direct	23	0.022	0	0			
		Sub-plot 2	1	9/22/2017	CV-00008	CV-00009	CV-00008	60	Direct	23	0.022	1	0.022			
			2	9/22/2017	CV-00010	CV-00011	CV-00010	60	Direct	23	0.022	12	0.26	0.0072	16	0.12
			3	9/22/2017	CV-00012	CV-00013	CV-00012	60	Direct	23	0.021	3	0.064			
		Sub-plot 3	1	9/22/2017	CV-00014	CV-00015	CV-00014	60	Direct	23	0.021	3	0.064			
			2	9/22/2017	CV-00016	CV-00017	CV-00016	60	Direct	23	0.021	1	0.021	0.0071	4	0.028
			3	9/22/2017	CV-00018	CV-00019	CV-00018	60	Direct	23	0.021	0	0			
	Deep Disturbance ABS	Sub-plot 1	1	9/22/2017	CV-00020	CV-00021	CV-00020	40	Direct	13	0.057	0	0			
			2	9/22/2017	CV-00022	CV-00023	CV-00022	40	Direct	16	0.058	2	0.12	0.019	4	0.077
			3	9/22/2017	CV-00024	CV-00025	CV-00024	40	Direct	16	0.058	2	0.12			
		Sub-plot 2	1	9/22/2017	CV-00026	CV-00027	CV-00027	20	Direct	34	0.055	0	0			
			2	9/22/2017	CV-00028	CV-00029	CV-00028	40	Direct	16	0.058	1	0.058	0.019	1	0.019
			3	9/22/2017	CV-00030	CV-00031	CV-00030	40	Direct	16	0.058	0	0			
		Sub-plot 3	1	9/22/2017	CV-00032	CV-00033	CV-00032	40	Direct	16	0.058	1	0.058			
			2	9/22/2017	CV-00034	CV-00035	CV-00034	40	Direct	16	0.058	0	0	0.019	1	0.019
			3	9/22/2017	CV-00037	CV-00036	CV-00037	40	Direct	16	0.058	0	0			

Table 2-7: Cover Treatability Study Summary of Analytical Data Results for ABS Air Samples

Scenario	ABS Type*	Sub-plot	Filter	Sample Date	Index ID*		Filter Analyzed?	Sample Air Volume (L)	Preparation Method	GOs Examined	PCME LAA			Pooled PCME LAA		
					HV	LV					Sensitivity (cc^{-1})	N Structures	Conc. (s/cc)	Sensitivity (cc^{-1})	N Structures	Conc. (s/cc)
Thin Biomass (1")	Shallow Disturbance ABS	Sub-plot 1	1	9/24/2017	CV-00076	CV-00077	CV-00076	61	Direct	28	0.022	1	0.022	0.0068	10	0.068
			2	9/24/2017	CV-00078	CV-00079	CV-00078	60	Direct	34	0.018	1	0.018			
			3	9/24/2017	CV-00080	CV-00081	CV-00080	60	Direct	29	0.021	8	0.17			
		Sub-plot 2	1	9/24/2017	CV-00082	CV-00083	CV-00082	61	Direct	30	0.020	0	0	0.0070	4	0.028
			2	9/24/2017	CV-00084	CV-00085	CV-00084	60	Direct	29	0.021	1	0.021			
			3	9/24/2017	CV-00086	CV-00087	CV-00086	60	Direct	30	0.021	3	0.062			
		Sub-plot 3	1	9/24/2017	CV-00088	CV-00089	CV-00088	60	Direct	29	0.021	0	0	0.0072	5	0.036
			2	9/24/2017	CV-00090	CV-00091	CV-00090	60	Direct	29	0.021	1	0.021			
			3	9/24/2017	CV-00092	CV-00093	CV-00092	60	Direct	29	0.021	4	0.086			
	Deep Disturbance ABS	Sub-plot 1	1	9/24/2017	CV-00094	CV-00095	CV-00094	40	Direct	16	0.058	0	0	0.019	2	0.038
			2	9/24/2017	CV-00096	CV-00097	CV-00096	40	Direct	13	0.057	1	0.057			
			3	9/24/2017	CV-00098	CV-00099	CV-00098	40	Direct	13	0.057	1	0.057			
		Sub-plot 2	1	9/24/2017	CV-00100	CV-00101	CV-00100	40	Direct	13	0.057	0	0	0.019	1	0.019
			2	9/24/2017	CV-00102	CV-00103	CV-00102	40	Direct	13	0.057	0	0			
			3	9/24/2017	CV-00104	CV-00105	CV-00104	40	Direct	13	0.057	1	0.057			
		Sub-plot 3	1	9/24/2017	CV-00106	CV-00107	CV-00106	40	Direct	14	0.053	0	0	0.019	2	0.037
			2	9/24/2017	CV-00108	CV-00109	CV-00108	40	Direct	13	0.057	0	0			
			3	9/24/2017	CV-00110	CV-00111	CV-00110	40	Direct	13	0.057	2	0.11			
Thick Biomass (4")	Shallow Disturbance ABS	Sub-plot 1	1	9/25/2017	CV-00112	CV-00113	CV-00112	60	Direct	30	0.021	1	0.021	0.0069	3	0.021
			2	9/25/2017	CV-00114	CV-00115	CV-00114	60	Direct	30	0.021	0	0			
			3	9/25/2017	CV-00116	CV-00117	CV-00116	60	Direct	30	0.021	2	0.042			
		Sub-plot 2	1	9/25/2017	CV-00118	CV-00119	CV-00118	60	Direct	30	0.021	0	0	0.0069	2	0.014
			2	9/25/2017	CV-00120	CV-00121	CV-00120	60	Direct	30	0.021	1	0.021			
			3	9/25/2017	CV-00122	CV-00123	CV-00122	60	Direct	30	0.021	1	0.021			
		Sub-plot 3	1	9/25/2017	CV-00124	CV-00125	CV-00124	60	Direct	30	0.021	0	0	0.0069	2	0.014
			2	9/25/2017	CV-00126	CV-00127	CV-00126	60	Direct	30	0.021	1	0.021			
			3	9/25/2017	CV-00128	CV-00129	CV-00128	60	Direct	30	0.021	1	0.021			
	Deep Disturbance ABS	Sub-plot 1	1	9/25/2017	CV-00130	CV-00131	CV-00130	40	Direct	16	0.058	1	0.058	0.019	2	0.037
			2	9/25/2017	CV-00132	CV-00133	CV-00132	40	Direct	14	0.052	0	0			
			3	9/25/2017	CV-00134	CV-00135	CV-00134	40	Direct	13	0.057	1	0.057			
		Sub-plot 2	1	9/25/2017	CV-00136	CV-00137	CV-00136	40	Direct	13	0.057	1	0.057	0.019	1	0.019
			2	9/25/2017	CV-00138	CV-00139	CV-00138	40	Direct	13	0.057	0	0			
			3	9/25/2017	CV-00140	CV-00141	CV-00140	40	Direct	13	0.057	0	0			
		Sub-plot 3	1	9/25/2017	CV-00142	CV-00143	CV-00142	40	Direct	13	0.058	1	0.058	0.019	3	0.058
			2	9/25/2017	CV-00144	CV-00145	CV-00144	40	Direct	13	0.058	0	0			
			3	9/25/2017	CV-00146	CV-00147	CV-00146	40	Direct	13	0.058	2	0.12			

Notes:

*Filters that were analyzed (shaded Index IDs)

red — HV filter was analyzed but rejected because it failed the Chi-Sq test for loading evenness

*Shallow disturbance ABS air samples were collected for 45 minutes total (15 minutes each sample); deep disturbance ABS air samples were collected for 30 minutes total (10 minutes per sample).

Filters were prepared and analyzed in basic accordance with TEM ISO 10312:1995(E) (ISO 1995), with all applicable Libby site-specific laboratory modifications.

ABS = activity-based sampling
cc^{-1} = per cubic centimeter of air
Conc. = concentration
GO = grid opening
HV = high volume
ID = identification
ISO = International Organization for Standardization
L = liter
LAA = Libby Amphibole Asbestos
LV = low volume
min = minute
N = number
PCME = phase contrast microscopy - equivalent
s/cc = structures per cubic centimeter
TEM = transmission electron microscopy

Table 2-8: Cover Treatability Study Data Analysis

Panel A: Percent Reduction in LAA Concentration in ABS Samples by Cover and Disturbance Scenario

ABS Type	Cover Type	Mean PCME LAA Concentration (s/cc)	Post-Cover to Pre-Cover Ratio[a]	% Reduction
Shallow Disturbance	Pre-Cover	0.029	N/A	N/A
	Post-Cover with Vegetation	0.062	2.17	No reduction
	Post-Cover with 1-inch Biomass	0.044	1.52	No reduction
	Post-Cover with 4-inch Biomass	0.016	0.56	44%
Deep Disturbance	Pre-Cover	0.08	N/A	N/A
	Post-Cover with Vegetation	0.039	0.48	52%
	Post-Cover with 1-inch Biomass	0.032	0.4	60%
	Post-Cover with 4-inch Biomass	0.038	0.48	52%
Average of Deep and Shallow Disturbances	Pre-Cover	0.054	N/A	N/A
	Post-Cover with Vegetation	0.05	0.93	7%
	Post-Cover with 1-inch Biomass	0.038	0.7	30%
	Post-Cover with 4-inch Biomass	0.027	0.5	50%

Notes:

[a]post-cover to pre-cover ratio<1 indicates a decrease in PCME LAA concentration in air when a cover is in place; post-cover to pre-cover ratio>1 indicates an increase in PCME LAA concentration in air when a cover is in place.

% - percent

N/A = not applicable

s/cc = structures per cubic centimeter

Panel B: Mean ABS PCME LAA Concentrations by Cover Type

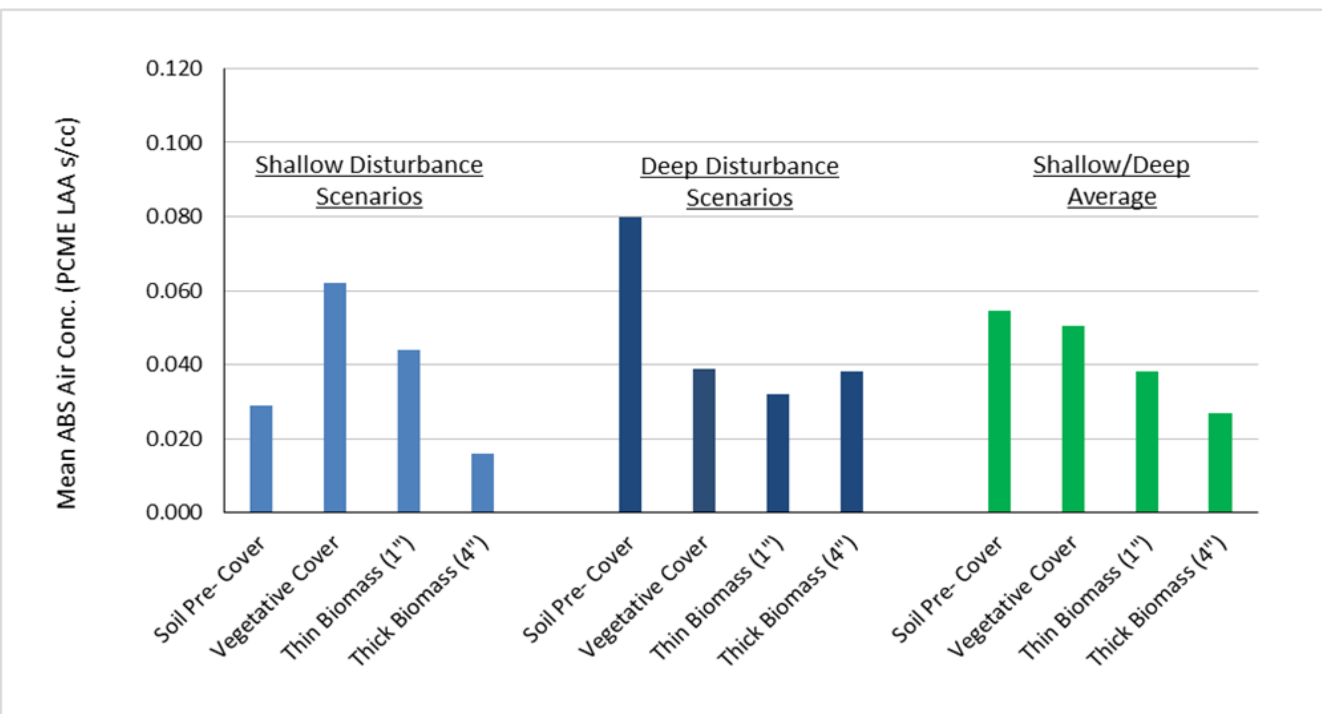


Table 2-9: 2018 Winter Hooking/Skidding ABS Study Summary of Field Data Results

Panel A: Meteorological Conditions during ABS Activities

Weather Parameter	Measurement from NOAA Station LBBM8	Measurement from Pocket Weather Meter
Wind Direction	southwest to north-northeast	not measured
Wind Speed	0 - 1 mph (occasional gust up to 4 mph)	0 – 1.5 mph
Air Temperature	19 – 27ºF	11 – 31ºF
Precipitation	0 inches	not measured
Relative Humidity	47 – 64%	42 – 49%

Notes:

Wind direction is reported in the direction from which it originates.

ºF - degree Fahrenheit

% - percent

mph - miles per hour

Panel B: Snow Depth Measurements

	Average Snow Depth Along Skid Path (inches)
Before ABS Activities	8.3-10.2
During ABS Activities	7.2-8.9

Table 2-10: Summary of Asbestos Results for ABS Air Samples Collected during the 2016 and 2018 Hooking/Skidding Studies

Sample Event	Index ID		Sample Date	Sample Air Volume (L)	Sample Duration (min)	Preparation Method	GOs Examined	Sensitivity (cc^{-1})	PCME LA		Pooled PCME LA		
	HV	LV							N Structures	Conc. (s/cc)	Sensitivity (cc^{-1})	N Structures	Conc. (s/cc)
Summer ABS 2016	WH-00340	WH-00341	9/16/2016	120	30	Direct	84	0.0037	6	0.022	0.00073	52	0.038
	WH-00343	WH-00344	9/16/2016	120	30	Direct	85	0.0037	7	0.026			
	WH-00345	WH-00346	9/16/2016	120	30	Direct	85	0.0037	10	0.037			
	WH-00347	WH-00348	9/16/2016	120	30	Direct	85	0.0037	7	0.026			
	WH-00349	WH-00350	9/16/2016	120	30	Direct	86	0.0036	22	0.080			
Winter ABS 2018	WH-10002	WH-10001	2/13/2018	120	30	Direct	88	0.0035	0	0	0.00075	2	0.0015
	WH-10004	WH-10003	2/13/2018	120	30	Direct	82	0.0038	0	0			
	WH-10006	WH-10005	2/13/2018	120	30	Direct	82	0.0038	0	0			
	WH-10008	WH-10007	2/13/2018	120	30	Direct	82	0.0038	1	0.0038			
	WH-10010	WH-10009	2/13/2018	120	30	Direct	84	0.0037	1	0.0037			

Ratio summer:winter 26

Notes:

*Filters that were analyzed (shaded Index IDs)

Filters were prepared and analyzed in basic accordance with TEM ISO 10312:1995(E) (ISO 1995), with all applicable Libby site-specific laboratory modifications.

All samples were collected from Area E.

ABS = activity-based sampling

cc^{-1} = per cubic centimeter of air

Conc. = concentration

GO = grid opening

HV = high volume

ID = identification

ISO = International Organization for Standardization

L = liter

LA = Libby amphibole asbestos

LV = low volume

min = minute

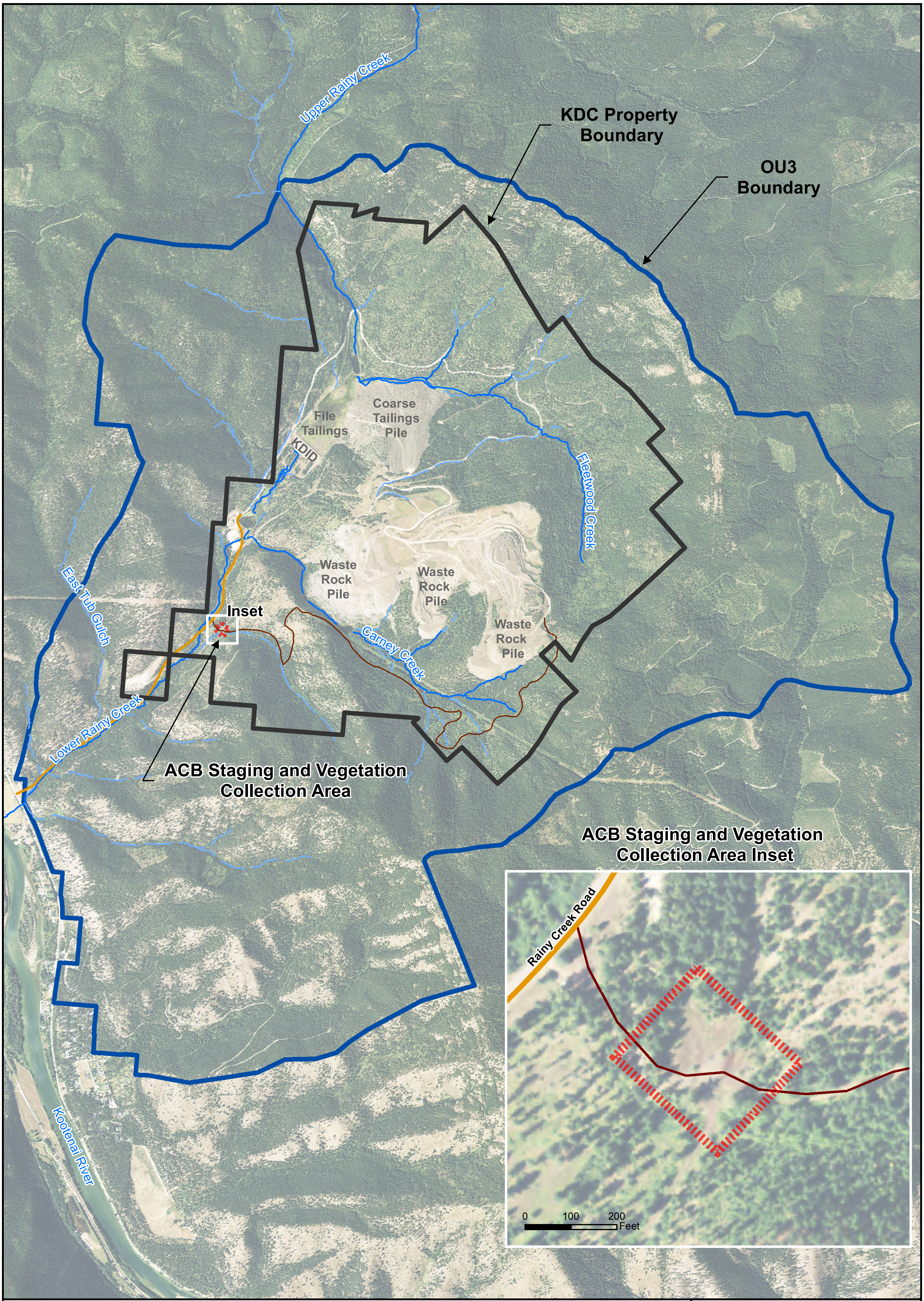
N = number

PCME = phase contrast microscopy - equivalent

s/cc = structures per cubic centimeter

TEM = transmission electron microscopy

FIGURES



Legend

- Carney Creek Access
- Rainy Creek Road (paved)
- Intermittent Stream
- Perennial Stream
- KDC Property Boundary
- OU3 Boundary
- ACB Staging and Vegetation Collection Area

ACB Air Curtain Burner
KDC Kootenai Development Company
KDID Kootenai Development Impoundment Dam
OU Operable Unit

Note: The portion of the Kootenai River that is included in OU3 is currently being negotiated.

N W E S

0 1,350 2,700 Feet

0 0.25 0.5 Miles

Base Image: National Agriculture Imagery Program, 2013
Coordinate System: NAD 1983 HARN StatePlane Montana FIPS 2500 Feet Intl
Date Revised: 6/25/2018
Report: OU3 2017 RI Addendum

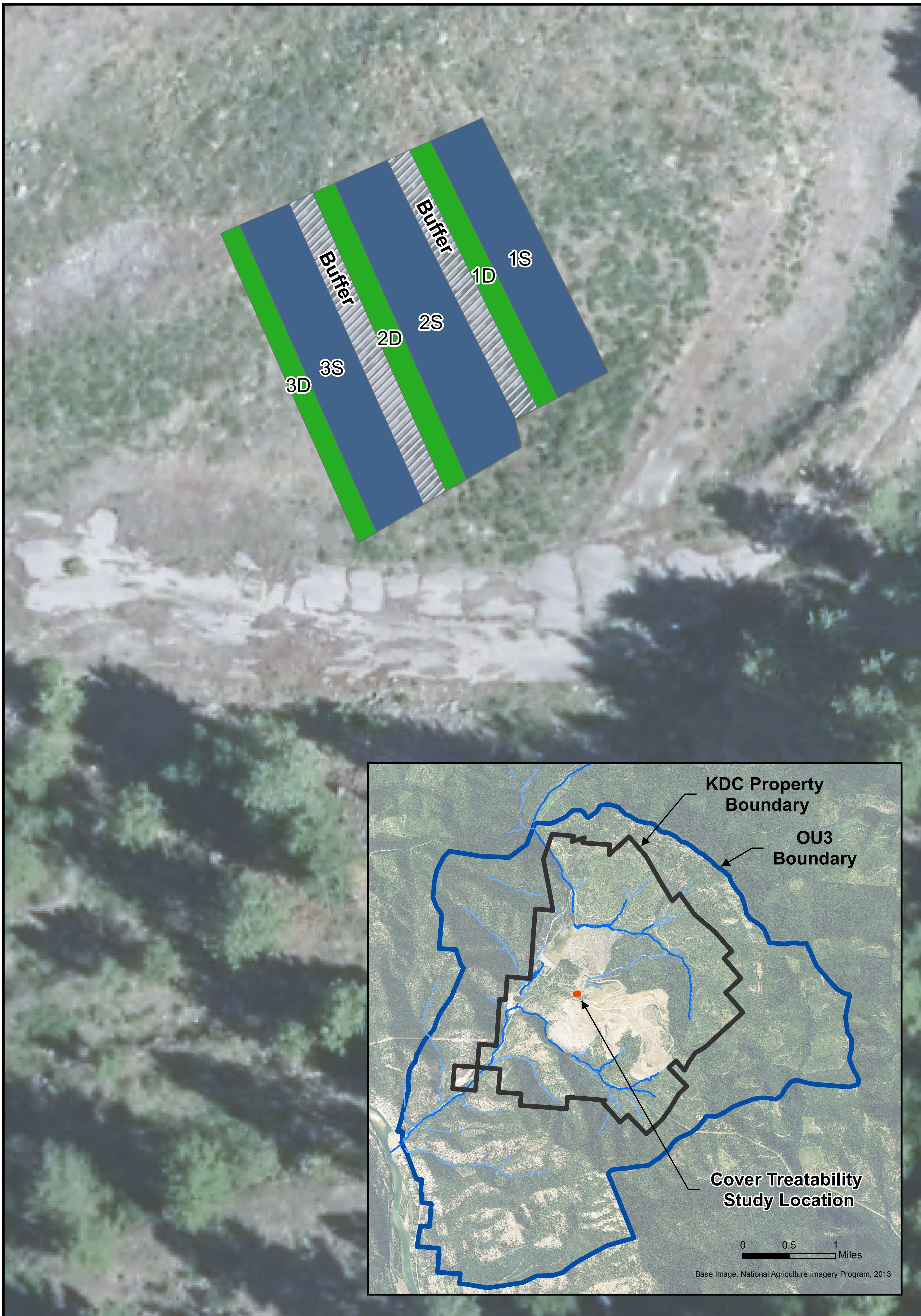
FIGURE 2-1

ACB Treatability Study Location

Libby Asbestos Superfund Site, OU3
W.R. Grace & Co.-Conn.

Stantec

File Path: U:\233001008\03_data\gis_cad_MXDs_CITRIX\FS_SAPs_TECHRPT\2017_TS_TECH_RPT\Libby_17TSRPT_Fig2-1_11x17_P_012518.mxd



Legend

- KDC Property Boundary
- OU3 Boundary
- Cover Treatability Study Location
- Intermittent Stream
- Perennial Stream
- Buffer Area
- Deep Disturbance Area
- Shallow Disturbance Area

KDC Kootenai Development Company
OU Operable Unit

Note: The portion of the Kootenai River that is included in OU3 is currently being negotiated.

N W E S

0 12.5 25 Feet

Base Image: LiDAR Flight Imagery, 2015
Coordinate System: NAD 1983 HARN StatePlane Montana FIPS 2500 Feet Intl
Date Revised: 6/25/2018
Report: OU3 2017 RI Addendum

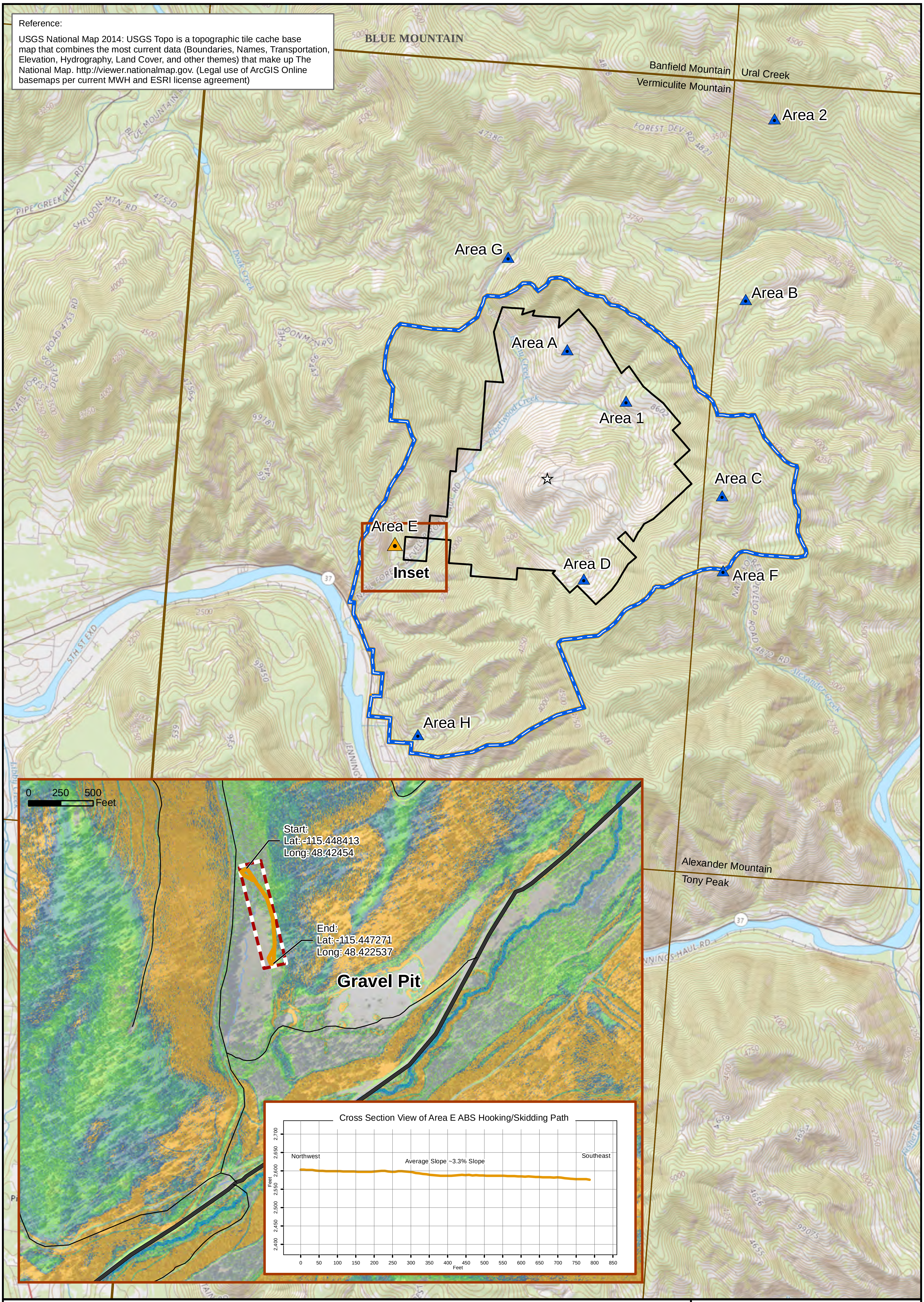
FIGURE 2-2

Cover Treatability Study Location and Layout

Libby Asbestos Superfund Site, OU3
W.R. Grace & Co.-Conn.

Stantec

File Path: U:\233001008\03_data\gis_cad_MXDs_CITRIX\FS_SAPs_TECHRPT\2017_TS_TECH_RPT\Libby_17TSRPT_Fig3-1_11x17_P_011018.mxd



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Legend

- Area E 2016 Hooking/Skidding Location
- Other 2016 Hooking/Skidding Locations
- Mine Center
- OU3 Boundary
- KDC Property Boundary
- USGS Quadrangle Boundary
- Area E Location
- Area E Hooking/Skidding Path
- Paved Road
- Gravel Road
- Perennial Stream or River
- Intermittent Stream

Note: The portion of the Kootenai River that is included in OU3 is currently being negotiated.

ABS Activity Based Sampling
KDC Kootenai Development Company
LiDAR Light Detection and Ranging
USGS United States Geological Survey

2015 LiDAR Slope %

- 0 - 10
- > 10 - 20
- > 20 - 30
- > 30 - 40
- > 40 - 50
- > 50

N E S W

0 3,250 6,500 Feet

0 0.5 1 Miles

Coordinate System: NAD 1983 HARN StatePlane Montana FIPS 2500 Feet Intl

Date Revised: 6/25/2018

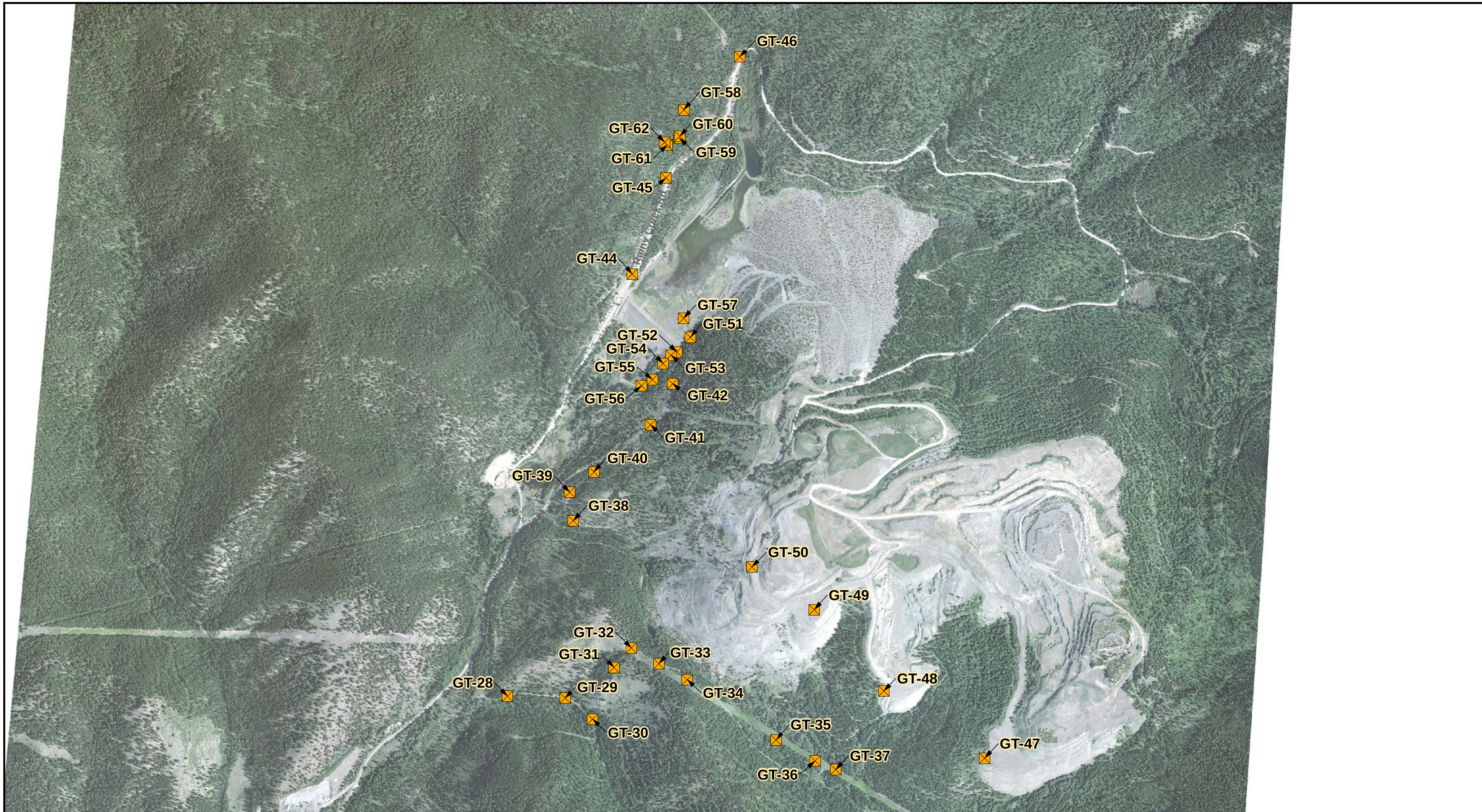
Report: OU3 2017 RI Addendum

FIGURE 2-3

Winter Hooking/Skidding ABS Area E

Libby Asbestos Superfund Site, OU3
W.R. Grace & Co.-Conn.

Stantec



Legend

Test Pit

N
W
E
S

0 700 1,400 2,800
Feet

Coordinate System: NAD 1983 HARN StatePlane Montana FIPS 2500 Feet Intl

Date Revised: 3/19/2018
Report: OU3 2017 RI Addendum

Figure 3-1
2017 Geotechnical and Hydrogeological Investigation Test Pit Locations
Libby Asbestos Superfund Site, OU3
W.R. Grace & Co.-Conn.

Stantec

File Path: U:\233001008\03_data\gis_cad_MXDs_CITRIX\Site_Engineering\2017_Field_Investigations\Libby_Mine_TestPits_2017_11x17_Landsc_20180319.mxd

Legend

⊕ Borehole

N W E S

0 300 600 1,200 Feet

Coordinate System: NAD 1983 HARN StatePlane Montana FIPS 2500 Feet Intl

Date Revised: 3/19/2018

Report: OU3 2017 RI Addendum

Figure 3-2
2017 Geotechnical and Hydrogeological Investigation Borehole Locations

Libby Asbestos Superfund Site, OU3

W.R. Grace & Co.-Conn.

Stantec

File Path: U:\233001008\03_data\gis_cad_MXDs_CITRIX\Site_Engineering\2017_Field_Investigations\Libby_Mine_Boreholes_2017_11x17_Landsc_20180319.mxd

ATTACHMENTS

ATTACHMENT A
2017 ANNUAL QA/QC SUMMARY REPORT

APTIM

APTIM Federal Services, LLC
QATS Program
2700 Chandler Avenue
Las Vegas, Nevada 89120

May 23, 2018

Christina Progess & David Berry
USEPA, Region 8
1595 Wynkoop Street (8EPR-SR)
Denver, CO 80202-1129

Document ID #: 1021-05232018-1

EPA CONTRACT NUMBER EP-W-16-016
TASK ORDER NUMBER 1021
QUALITY ASSURANCE SUPPORT FOR RI/FS AT THE LIBBY ASBESTOS SITE OU3

Dear Ms. Progess and Dr. Berry:

Enclosed please find the final Annual QA/QC Summary Report (2017). This report is a deliverable under Task 9 of Task Order 1021.

If you have any questions, please feel free to contact me.

Sincerely,

Lyndsay Gensler
Task Leader, QATS Program
E-Mail Address: lyndsay.gensler@aptim.com
Phone: (702) 895-8730
APTIM Federal Services, LLC

APTIM Federal Services, LLC
QATS Program
2700 Chandler Avenue
Las Vegas, Nevada 89120

ANNUAL QA/QC SUMMARY REPORT (2017)

FOR TASK ORDER 1021
QUALITY ASSURANCE (QA) SUPPORT FOR REMEDIAL INVESTIGATION/FEASIBILITY STUDY (RI/FS) AT SITE OU3

Prepared by:

The Data Auditing Group
Quality Assurance Technical Support Program
APTIM Federal Services, LLC
2700 Chandler Avenue
Las Vegas, Nevada 89120

May 23, 2018

QATS Contract Number: EP-W-16-016

Prepared for:

Christina Progess and David Berry

Task Order Manager
Remedial Project Manager
U.S. EPA Region 8
1595 Wynkoop Street (8EPR-SR)
Denver, CO 80202-1129

Through:

Sara Duncan

Analytical Services Branch
U.S. Environmental Protection Agency
Washington, D.C. 20460

OFFICE OF SUPERFUND REMEDIATION AND TECHNOLOGY INNOVATION
U. S. ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

Table of Contents

Acronym List

<	Less Than
≥	Greater Than or Equal To
%	Percent
AHERA	Asbestos Hazard Emergency Response Act
ABS	Activity-based Sampling
AOC	Administrative Order on Consent
ASTM	American Society for Testing and Materials
CB	Compact Bundle
CB&I	Chicago Bridge and Iron Company
CBO	Compact Bundle Obscured
CC	Compact Cluster
CF	Compact Fiber
CFO	Compact Fiber Obscured
CH	Chrysotile
CI	Confidence Interval
COC	Chain-of-Custody
CSF	Close Support Facility
EDD	Electronic Data Deliverable
EDS	Electron Diffraction System
EPA	Environmental Protection Agency
ESAT	Environmental Services Assistance Team
f/cc	Fibers per Cubic Centimeter
f/mm^2	Fibers per Square Millimeter
FB	Field Blank
FBAS	Fluidized Bed Asbestos Segregator
FG	Finely Ground
GO	Grid Opening
IL	Inter-laboratory
ISO	International Organization for Standardization
ISSI	ISSI Consulting Group, Inc.
LA	Libby Amphibole
LB	Laboratory Blank
LC	Laboratory Coordinator
LDC	Laboratory Duplicate Cross-check
LDS	Laboratory Duplicate Self-check
MAS	Material Analytical Services, LLC
MB	Matrix Bundle
MBO	Matrix Bundle Obscured
MC	Matrix Cluster
MFL	Million Fibers per Liter
MF	Matrix Fiber
MFO	Matrix Fiber Obscured
NA	Not Applicable
NAM	Non-asbestos material
ND	Non-Detect
NIOSH	National Institute for Occupational Safety and Health
NVLAP	National Voluntary Laboratory Accreditation Program
OA	Other Amphibole
OU	Libby Operable Unit
PC	Point Count
PCM	Phase Contrast Microscopy
PCMe	PCM-Equivalent
PES	Performance Evaluation Sample
PLM	Polarized Light Microscopy
PLM-Grav	Polarized Light Microscopy Gravimetric
PLM-VE	Polarized Light Microscopy-Visual Area Estimation
QAM	Quality Assurance Manager
QAPP	Quality Assurance Project Plan
QA	Quality Assurance
QARD	Quality Assurance Reference Document
QATS	Quality Assurance Technical Support
QC	Quality Control
RD	Recount Different
RI/FS	Remedial Investigation/Feasibility Study
RP	Re-preparation
RPD	Relative Percent Difference
ROM	Record of Modification
RS	Recount Same
SAED	Selected Area Electron Diffraction
SAP	Sampling and Analysis Plan
s/cc	Structures per Cubic Centimeter
SOP	Standard Operating Procedure
SPF	Soil Preparation Facility
SRM	Solid Reference Material
TAT	Turn-around Time
TEM	Transmission Electron Microscopy
VA	Verified Analysis

1.0 Introduction

1.1 Purpose of this Report

This Annual Summary Report provides a summary of the Quality Assurance (QA) activities applied to asbestos sample data collected from Libby Superfund Site Operable Unit (OU) that occurred in 2017. The QC activities include the assessment of QC data, asbestos sample data validation, on-site laboratory audits, laboratory mentoring, and recommendations for improvements. Operable Unit 3 (OU3) is one of eight OUs designated by EPA for the Libby Remedial Investigation/Feasibility Study (RI/FS), which encompasses the mine property and surrounding areas impacted by releases from the mine, such as creeks, the Kootenai River, settling ponds, nearby forests, and Rainy Creek Road. The primary contaminant at OU3 is Libby Amphibole (LA) which is a form of asbestos present in the vermiculite that was mined at the site from 1919 to 1990. The Libby RI/FS at OU3 is being conducted through an Administrative Order on Consent (AOC) entered into by EPA with respondents W.R. Grace and Co. and Kootenai Development Corporation (KDC). This report was prepared for the U.S. Environmental Protection Agency (EPA) Region 8 by APTIM Federal Services, LLC's Quality Assurance Technical Support (QATS) Program under Task 9 of Task Order 1-021, *QA Support for RI/FS at Site OU3.*

1.2 Report Outline

The 2017 OU3 QA/QC assessments described in this report include:

- QC Data Evaluated
- Asbestos Data Validation
- Laboratory On-site Audits
- Laboratory Mentoring Program
- Conclusions and Recommendations

2.0 QC Data Evaluated

The QC data described in this section are from samples which were collected from the OU3 site and analyzed in 2017 by the EPA contract laboratories listed in **Table 1**, below.

Table 1 – 2017 Libby Laboratories

Abbreviation	Name, Location
EMSL03*	EMSL Analytical, Inc., New York, NY
EMSL04	EMSL Analytical, Inc., Cinnaminson, NJ
EMSL22*	EMSL Analytical, Inc., Denver, CO
EMSL32	EMSL Analytical, Inc., Libby, MT
ESATR8	ESAT Region 8, Golden, CO

* Although select laboratories did not directly analyze field samples from OU3 in 2017, they did participate in the on-site audit program for the year.

In 2017 EPA initiated two studies, or investigation phases, at the OU3 site. These include the Air Curtain Burner Surface Covers (AC) and AC Cover (CV) studies. **Table 2** presents the investigation phases with titles and the approximate dates in which they were initiated at the Libby OU3 Superfund Site.

Table 2 – 2017 Libby OU3 Site Investigation Phases

Requirements Summary	SAP Phase Title	SAP/QAPP Date
ACBOU3-0617 (AC)	2017 Phase 1 Feasibility Study Treatability Studies, Air Curtain Burner Study, Surface Covers Study, Revision 0	June 2017
COVEROU3-0917 (CV)	2017 Phase 1 Feasibility Study Treatability Studies, Air Curtain Burner Study, Cover Study, Revision 1	August 2017

In 2017 EPA Region 8 estimated that analyses for Libby OU3 would include eight perimeter air and one ash (analyzed in triplicate) field samples for the AC study and 72 activity-based sampling (ABS) air field samples for the CV study. Actually analyzed were 14 field samples (including two lot blanks and one ash blank in triplicate) for the AC study and 79 field samples for the CV study (including two lot blanks). In total, including laboratory blanks and QC, 24 AC samples and 113 CV samples were analyzed for the 2017 OU3 projects (137 samples total). All of the samples from both studies were air samples, with the exception of one ash sample analyzed in triplicate and its associated laboratory blank. All samples were analyzed by EPA contract laboratories using the transmission electron microscopy (TEM) ISO 10312 method.

To determine and document the quality of the asbestos analyses conducted in support of these phases, EPA requires Quality Control (QC) analysis to accompany field sample analysis at frequencies and criteria goals as specified in Libby OU3 Laboratory Modifications and Sampling and Analysis Plans (SAPs). Two types of QC analyses are applied to the Libby OU3 samples collected in 2017:

- Field QC Analyses
- Laboratory QC Analyses

2.1 Field QC Analyses

All of the field QC samples for OU3 in 2017 were analyzed by TEM.

Two types of field QC analyses were applied to Libby OU3 samples analyzed in 2016: field duplicates, field blanks, and lot blanks. These are defined as follows:

Field blanks – QC samples which are collected to evaluate potential contamination introduced during sample collection, shipping and handling, or analysis. For the 2017 OU3 AC and CV projects, air field blanks were collected at a frequency of one field blank per day of collection.

Lot blanks – QC samples which are selected at random from each group of cassettes to be used for collection of air samples. Before air filter cassettes can be used for asbestos sampling, though, the lot must be asbestos-free. The selected lot blanks are analyzed for asbestos fibers by the same method used for field sample analysis. If any asbestos fibers are detected on the lot blanks, the entire batch of cassettes is rejected. Only lots of filters with acceptable lot blank results are placed in the general supply area for use by project personnel. For the 2017 OU3 AC and CV projects, two lot blanks were randomly selected for TEM analysis.

Field QC are collected at the frequencies specified in Section B5 Quality Assurance/Quality Control of the project-specific QAPPs, and are specific to each media type as described above.

2.1.1 Field QC Results

Table 3 presents the TEM field QC sample summary for field blanks and lot blanks related to the 2017 OU3 sampling events.

Table 3 – 2017 OU3 TEM Field QC Summary

Phase	Media	# of Field Samples		Field QC (frequency requirement)	
		Total	# of Not QC	# of Field Blanks (1/sampling day)	# of Lot Blanks (2/lot)
AC	Air	11	8	1	2
	Ash[1]	3	3		
CV	Air	79	73	4	2
	TOTALS	**93**	**87**	**5**	**4**

[1] The single ash sample was prepared and analyzed in triplicate.

The frequency requirements for TEM field blanks and lot blanks specified by the QAPP were met for the 2017 OU3 sampling events, as indicated in **Table 3**. All nine of the field and lot blank samples analyzed by TEM met the requirement criteria with non-detect (ND) results.

2.2 Laboratory QC Analysis

A variety of laboratory-based QC analyses are performed for TEM sample analyses, which are used to assess the quality of the associated sample data. The results of laboratory QC applied to samples collected from the Libby OU3 Superfund site and analyzed by the contract laboratories (**Table 1**) in 2017, are described below.

2.2.1 TEM Laboratory QC

The laboratory QC requirements for TEM analyses at the Libby OU3 site are patterned after the requirements set forth by NVLAP, which include:

- TEM Laboratory Blanks (LBs)
- TEM Recount Analyses (RS, RD, and VA)
- TEM Re-preparations (RPs)
- TEM Inter-laboratory (IL) Analyses

Each of these TEM laboratory QC types have Phase-specific, program-wide frequency goal requirements as a percentage of the field samples analyzed. **Table 4** provides summaries of the number and frequency of TEM laboratory QC analyses performed for all media by laboratory in 2017.

Table 4 – 2017 OU3 TEM QC Sample Frequency

Lab	# of Field Samples	Laboratory QC (% Frequency Goal)											
		Blanks (4%)		RS (1%)		RD (2.5%)		VA (1%)		RP (1%)		IL* (1%)	
		#	%	#	%	#	%	#	%	#	%	#	%
EMSL04	30	7	23.3%	1	3.3%	1	3.3%	0	0.0%	0	0.0%	2	6.7%
EMSL32	19	4	21.1%	0	0.0%	1	5.3%	0	0.0%	1	5.3%	1	5.3%
ESATR8	44	8	18.2%	2	4.5%	5	11.4%	2	4.5%	2	4.5%	2	4.5%
TOTALS	**93**	**19**	**20.4%**	**3**	**3.2%**	**7**	**7.5%**	**2**	**2.2%**	**3**	**3.2%**	**5**	**5.4%**

* IL values represented by only the RP-IL analysis of the sample.

As summarized in **Table 4**, a total of 19 laboratory blanks, seven RD, three RS and RP, and two VA TEM analyses were performed in 2017 across the OU3 phases. A total of five IL samples were analyzed for the 2017 OU3 phases, representing a total frequency of 5.4%, which exceeds the overall program goal of 1% IL frequency. For the IL study, with five samples total, each laboratory performed the same number of analyses as both the original (RP-IL) laboratory and the second (IL) laboratory.

As illustrated in **Table 4**, the TEM Laboratory QC sample frequency requirements for blanks, RS, RD, VA, RP, and IL QC samples were exceeded (by total) for all laboratories and phases combined. While some laboratories did not meet the percent frequency goals on an individual level, the TEM QC frequency requirements for the 2017 OU3 sampling events, six in total, met the OU3 QC requirements specified in Laboratory Modification LB-00029 for the program.

2.2.1.1 TEM Blanks

As shown in **Table 4**, a total of 19 blank sample analyses (20.4% of the total number of samples) were reported during the year. No asbestos structures were found in any of the 2017 OU3 TEM laboratory QC blank analyses, and as a result are classified as "Good" based on the TEM recount program-wide concordance criteria of 0.0-0.1% with ≥1 asbestos structures, as summarized in **Table 6** below.

The 2017 OU3 TEM sample blanks were represented by laboratory blanks (LBs) which are prepared from new, unused filters and analyzed using the same procedures as applied to field samples. The purpose of a LB is to determine the presence of asbestos contamination during sample preparation and analysis in the TEM laboratory. As specified in Libby Laboratory Modification LB-000029 and the applicable SAPs (see **Section 8.0 References** of this report), LBs are to be analyzed at a frequency of 4.0%. All individual laboratories met the frequency goals for performing LBs, with 19 LBs analyzed for an overall frequency of 20.4%.

2.2.1.2 TEM Recount Analyses

A recount analysis is an intra-laboratory re-examination of the original TEM grid openings (GOs) to verify the reported asbestos structure counts and characteristics. Three types of recount analyses were performed by the 2016 OU3 TEM analytical laboratories:

- Recount Same (RS) – Select original GOs, usually the ten with the highest number of LA structures, are re-examined by the same microscopist who performed the initial examination.
- Recount Different (RD) – Select original GOs, usually the ten with the highest number of LA structures, are re-examined by a microscopist within the same laboratory who did not perform the initial examination.
- Verified Analysis (VA) – Similar to RD but with different documentation requirements, a VA must be recorded in accordance with the NIST (1994) protocol requirements.

Recount analyses were compared with the original analysis on a GO-by-GO, and structure-by-structure basis, with only those GOs that were able to be re-examined during the recount analysis included in the evaluation; in some instances grid openings may have been damaged with no alternates available. The degree of concordance between the original analysis and the recount analysis was evaluated based on the total number of countable LA structures observed for each grid opening that was re-examined. The concordance metrics, as defined in LB-000029, are summarized in **Table 5**.

Table 5 – TEM Recount Analysis Concordance Rules

Measurement Parameter	Concordance Rule
Number of LA structures within each grid opening	For grid openings with 10 or fewer structures, counts must match exactly. For grid openings with more than 10 structures, counts must be within 10 percent (%) as calculated as relative percent difference (RPD) (((maximum count – minimum count)/average count)*100%).
Asbestos class of structure (LA, OA, CH)	Must agree 100% on Chrysotile (CH) vs. amphibole. For assignment of amphiboles to LA or other amphibole (OA) bins, must agree on at least 90% of all amphibole structures.
LA Structure length	For fibers and bundles (all methods) and compact fiber (CF), compact bundle (CB), matrix fiber (MF), and matrix bundle (MB) structures (ISO), must agree within 1 micron (µm) or 10% (whichever is less stringent). For clusters and matrices (AHERA and ASTM) and compact fiber obscured (CFO), compact bundle obscured (CBO), compact cluster (CC), matrix fiber obscured (MFO), matrix bundle obscured (MBO), and matrix cluster (MC) structures (ISO), must agree within 2 µm or 20% (whichever is less stringent). The above percentages (%) are to be calculated as RPD (((1st analysis length – 2nd analysis length)/average length)*100%).
LA Structure width	For fibers and bundles (all methods) and CF, CB, CFO, CBO, MF, MB, MFO, and MBO structures (ISO), must agree within 0.5 µm or 20% (whichever is less stringent). For clusters and matrices (AHERA and ASTM) and CC and MC structures (ISO), there is no quantitative rule for concordance. The above percentage (%) is to be calculated as RPD (((1st analysis width – 2nd analysis width)/average width)*100%).
Presence of Sodium (Na) and Potassium (K)	There is no rule for concordance, but must be tabulated to identify potential trends that may indicate inconsistencies in recording practices or interpretation of spectra.

The TEM recount program-wide concordance criteria, as defined in LB-000029, are summarized in **Table 6**.

Table 6 – TEM Recount Program-wide Criteria

QC Sample Type	Metric	Program-wide Criteria		
		Good	Acceptable	Poor
Lab Blanks	% with ≥1 asbestos structures	0% - 0.1%	0.2% - 0.5%	>0.5%
Recounts	Concordance on LA count*	>95%	85%-95%	<85%
	Concordance on type (chrysotile vs. amphibole)	>99%	95%-99%	<95%
	Concordance on type (LA vs. other amphibole)	>99%	95%-99%	<95%
	Concordance on type (LA vs. NAM)	>99%	95%-99%	<95%
	Concordance on LA length	>90%	80%-90%	<80%
	Concordance on LA width	>90%	80%-90%	<80%

Table 6 – TEM Recount Program-wide Criteria

QC Sample Type	Metric	Program-wide Criteria		
		Good	Acceptable	Poor
Re-preparations	Concordance on LA concentration/loading	>95%	90%-95%	<90%

* Identified as Structures per GO throughout the applicable tables in this report.

Table 7 shows the TEM recount analysis results for the seven RD, three RS, and two VA OU3 analyses performed in 2017. The recount results for all media and phase were combined, and are shown by mineral class, structure length, structure width, and matched structures per grid opening.

Table 7 – 2017 OU3 TEM Intra-laboratory Recount Analysis Results

Results for Matched LA Structures				
Media	**Attribute**	**Total**	**Pass**	**%**
Air	LA vs. NAM	1	0	0%
	LA vs. OA	0	0	NA
	LA vs. CH	0	0	NA
	Structures per GO[1]	111	111	100%
	Structures per GO[2]	41	41	100%
	Structure Length	41	41	100%
	Structure Width	41	41	100%
	Na/K Presence	41	40	98%

LA – Libby Amphibole OA – Other Amphibole CH – Chrysotile NAM – Non-asbestos Material
Structures per GO[1] – All grid openings, including those that did not contain reportable structures.
Structures per GO[2] – Grid openings that contained reportable structures.

As illustrated in **Table 7** above, the overall recount attributes for mineral class (LA vs. OA and LA vs. CH), concordance on LA count (structures per GO, including and excluding non-detects), structure length, and structure width were in the "Good" category, and concordance on mineral class (LA vs. NAM) was in the "Poor" range at 0%, with the only sample reporting a NAM structure, having not been confirmed in the QC evaluation. Though there is no rule for concordance for the presence of Na/K, the attribute is tabulated for each structure in order to identify potential trends which may indicate inconsistencies in recording practices or interpretation of spectra.

In addition to the LB-000029 requirements, 100% (12 out of 12) TEM recount analysis results were within the applicable NISTR (NVLAP) requirements.

Unmatched structures are those structures either identified by the original (1st) analysis, but not the QC (2nd) analysis, or those identified by the QC analysis, but not the original analysis. **Table 8** below shows the unmatched structures by laboratory, unadjusted for ambiguous structures.

Table 8 – 2017 OU3 TEM Intra-laboratory Recount Analysis Structures Missed – By Laboratory

Laboratory	Structures Found		Structures Missed	
	Original	QC	#	%
EMSL04	2	2	0	0.0%
EMSL32	2	2	0	0.0%
ESATR8	34	34	0	0.0%
TOTALS	**38**	**38**	**0**	**0.0%**

By laboratory, matched structures were identified with 100% confirmation by all three laboratories which analyzed samples for OU3 in 2017: EMSL04 and EMSL32 (each with 2/2 structures) and ESATR8 (34/34 structures).

2.2.1.3 TEM Re-preparations

A TEM re-preparation (RP) is the re-analysis of a sample from which new grids have been prepared using a different portion of the same field sample filter used to prepare the original grids. The 2017 OU3 RP results were compared to the original analyses using the method for comparison of two Poisson rates described by Nelson (1982), based on a 90% confidence interval (CI). RPs provide information on analysis precision, as well as within-filter variability.

Table 9 presents the statistical comparison for the original and RP analyses as identified by sample number for the 2017 OU3 phases, representing the total LA. In 2017, three sample RPs were prepared out of 93 TEM field samples analyzed across all OU3 phases and laboratories, for a frequency of 3.2% (see **Table 4**). Of these three RPs, none were found to be statistically different from the original analyses (see **Table 9**) with 100% of RP analyses results within the established criteria. When compared to the program-wide goals, the 100% acceptable RP analyses rates as “Good” (>95%). Note that, unless otherwise indicated, where the LA structure counts are different between the first and second evaluations, the 90% CI requirement is still met.

Table 9 – 2017 OU3 Re-preparation Statistical Comparison Using Two Poisson Rates – Total LA

Laboratory	Field Sample ID	Method	Media	First Evaluation		Second Evaluation		Poisson Ratio Rate Comparison (CI=90%)
				Count	Sens [a]	Count	Sens [a]	
ESATR8	AC-00006	TEM-ISO	Air	0	1.76E-02	0	1.76E-02	Both counts are 0; the rates are not different
EMSL32	CV-00010	TEM-ISO	Air	12	2.18E-02	12	2.16E-02	[0.47-2.15] The rates are not different
ESATR8	CV-00116	TEM-ISO	Air	2	2.08E-02	3	2.08E-02	[0.08-4.28] The rates are not different

Sens [a]: Air $(cc)^{-1}$

Table 10 presents the statistical comparison for the original (first evaluation) and field duplicate (second evaluation) PCMe LA Structures analyses and are identified by laboratory and sample number, as analyzed by the TEM-ISO method.

Table 10 – 2017 OU3 Re-preparation Statistical Comparison Using Two Poisson Rates – PCMe LA Structures

Laboratory	Field Sample ID	Method	Media	First Evaluation		Second Evaluation		Poisson Ratio Rate Comparison (CI=90%)
				Count	Sens [a]	Count	Sens [a]	
EMSL32	CV-00010	TEM-ISO	Air	12	2.18E-02	12	2.16E-02	[0.47-2.15] The rates are not different
ESATR8	CV-00116	TEM-ISO	Air	2	2.08E-02	3	2.08E-02	[0.08-4.28] The rates are not different

Sens [a]: Air $(cc)^{-1}$

As presented in **Table 10**, when considering PCMe LA structure results only, both sample pairs resulted in first and second evaluation rates which were not statistically different.

All three of the results (100%) for the RP samples compared when evaluating for total LA and PCMe LA structures-only were within the 90% CI. Additionally, the re-preparation QC samples are classified as "Acceptable" based on the TEM recount program-wide concordance criteria

(**Table 6**) of 90-95% concordance on LA, with 93% LA concordance (14 of 15 LA detected and confirmed) between the three RP samples.

2.2.1.4 TEM Inter-laboratory Analyses

Five OU3 samples for the 2017 TEM re-preparation/inter-laboratory (RP/IL) analyses were selected in accordance with the most recent revision of Laboratory Modification LB-000029. These samples included two air samples related to the AC study and three air samples related to the CV study. The list was provided to each of the Libby contract laboratories, who then retrieved the samples from archive storage, prepared the TEM grids, analyzed the samples, prepared the paperwork, and shipped the grids to the laboratory selected to perform the IL analyses. Upon receipt of the grid preparations at the laboratory scheduled to perform the second IL analysis, the GOs selected by the RP laboratory are reanalyzed in accordance with the same rules applied to the RP analyses. The criteria for TEM IL analyses are the same as those for the other recount analyses, described in **Section 2.2.1.2** above.

The samples selected for the 2017 OU3 TEM IL study are presented in **Table 11**, with the first analyses performed by the original (RP) laboratory, and the second analyses performed by the IL laboratory. Preference is typically given in the selection process to those samples with the highest number of structures per GOA; however, for this IL study, it was necessary to select a sample which were originally reported as ND to satisfy the TEM IL study requirements for each phase study.

Table 11 – Samples Selected for 2017 OU3 TEM IL Study

Sample Number	Media	Analysis Method	RP Laboratory	IL Laboratory
AC-00008	Air	ISO10312	ESATR8	EMSL04
AC-00013	Air	ISO10312	EMSL04	ESATR8
CV-00024	Air	ISO10312	ESATR8	EMSL32
CV-00038	Air	ISO10312	EMSL04	ESATR8
CV-00048	Air	ISO10312	EMSL32	EMSL04

As illustrated above in **Table 11**, the participation in the 2017 OU3 TEM IL study is fairly evenly distributed among the laboratories, with EMSL04 and ESATR8 each conducting two RP and two IL analyses, and EMSL32 conducting one RP and one IL analysis.

Table 12 provides a summary of the overall 2017 OU3 TEM IL results, across all laboratories and overall.

Table 12 – 2017 OU3 TEM Inter-laboratory Analyses Results – By Laboratory & Overall

Results for Matched LA Structures										
Lab	**Attribute**	**Total**	**Pass**	**%**		**Lab**	**Attribute**	**Total**	**Pass**	**%**
EMSL04	LA vs. NAM	0	0	NA		ESATR8	LA vs. NAM	0	0	NA
	LA vs. OA	0	0	NA			LA vs. OA	0	0	NA
	LA vs. CH	0	0	NA			LA vs. CH	0	0	NA
	Structures per GO[1]	28	28	100.0%			Structures per GO[1]	28	28	100.0%
	Structures per GO[2]	6	6	100.0%			Structures per GO[2]	4	4	100.0%
	Structure Length	6	6	100.0%			Structure Length	4	4	100.0%
	Structure Width	6	6	100.0%			Structure Width	4	4	100.0%
	Na/K Presence	6	5	83.3%			Na/K Presence	4	4	100.0%

Table 12 – 2017 OU3 TEM Inter-laboratory Analyses Results – By Laboratory & Overall

Results for Matched LA Structures										
Lab	**Attribute**	**Total**	**Pass**	**%**		**Lab**	**Attribute**	**Total**	**Pass**	**%**
EMSL32	LA vs. NAM	0	0	NA		Totals	**LA vs. NAM**	**0**	**0**	**NA**
	LA vs. OA	0	0	NA			**LA vs. OA**	**0**	**0**	**NA**
	LA vs. CH	0	0	NA			**LA vs. CH**	**0**	**0**	**NA**
	Structures per GO[1]	20	20	100.0%			**Structures per GO[1]**	**38**	**38**	**100.0%**
	Structures per GO[2]	4	4	100.0%			**Structures per GO[2]**	**7**	**7**	**100.0%**
	Structure Length	4	4	100.0%			**Structure Length**	**7**	**7**	**100.0%**
	Structure Width	4	4	100.0%			**Structure Width**	**7**	**7**	**100.0%**
	Na/K Presence	4	3	75.0%			**Na/K Presence**	**7**	**6**	**85.7%**

LA – Libby Amphibole OA – Other Amphibole CH – Chrysotile NAM – Non-asbestos Material
Structures per GO[1] – All grid openings, including those that did not contain reportable structures.
Structures per GO[2] – Grid openings that contained reportable structures.
Note: For Sample CV-00048, the IL analysis by EMSL04 only evaluated the GOs in 1 Grid (Grid O2).

As presented in **Table 12**, IL sample pair analyses were within the "Good" range of the program-wide criteria (**Table 6**) specified for Asbestos Class of Structure (LA vs. NAM, OA, or CH), Structure Length, Structure Width, and Structures per GO, without exception. Note that no program-wide criteria from **Table 5** apply to NaK. In addition to the LB-000029 requirements, 100% (5 out of 5) RP/IL sample pair results were within the applicable NISTR (NVLAP) requirements.

3.0 Asbestos Data Validation

In 2017, asbestos air media data from 26 of the 137 Libby OU3 samples analyzed for the AC and CV projects were validated by the QATS Program. Data validation was performed in accordance with the applicable TEM ISO 10312 method, SAP Analytical Requirements Summary (ACBOU3-0617 and COVEROU3-0917), Laboratory Modifications, and QATS Libby-specific data validation SOPs. The validation SOP applied by the QATS Program included SOP QATS-70-095 (Validation of Libby Transmission Electron Microscopy (TEM) Data Deliverables).

The validation process involves evaluating asbestos data based on the analytical requirements in the applicable method or SOP used by EPA for analysis of samples collected at Libby Superfund Site OUs. Criteria that are evaluated and reported include sample receipt, sample preparation, microscope alignment, instrument calibrations, stopping rules, structure recording and identification, blank analysis (if applicable), recount/re-preparation analysis (if applicable), and overall assessment of data.

Data are qualified if the daily or monthly calibrations associated with a sample set were not performed at the required frequency, or if the calibrations fail to meet method requirements. The equipment alignment and calibration documentation from each of the Libby support laboratories are provided separately on a quarterly basis. This calibration information is entered into laboratory-specific spreadsheets, where the data validators can access the information and verify that the calibrations were acceptable and performed at the correct frequency for the analyses being evaluated.

B-qualifiers for blank contamination are applied during the validation process for those blanks directly associated with field samples (i.e., provided with a particular deliverable selected for validation). In addition to those QC analyses reviewed during the validation of select deliverables, QC analyses are also reviewed and evaluated on a program-wide basis to ensure they are both performed at the required frequency and that they are within the applicable criteria. With the exception of QC analyses directly associated with a particular set of samples, laboratory QC analyses are performed to determine the quality of the collective data, and not the quality of any specific single set of samples.

The data validation process also includes a comparison of the information reported on the bench sheets to the entries in the associated laboratory method-specific EDDs to ensure that the reported results are complete, compliant with the specified methodology, and accurate. These comparison discrepancies are noted in a separate table of the data validation report. An EPA-approved QATS Data Review Checklist is used to document the data validation process.

Of the total 137 OU3 sample results, 26 (19.0%) were validated from the 2017 OU3 samples, from four Laboratory Job Numbers and analyzed by three different laboratories. The phase, laboratories, chain-of-custody (COC) numbers, Laboratory Job Numbers, method, matrix, and sample counts are presented, as follows, in **Table 13** for the asbestos data:

Table 13 – 2017 OU3 Asbestos Sample Data Validation Summary

Phase	Lab	COC #	Laboratory Job #	Method	Matrix	Total Sample Analyses	Field Samples (Not QC)	Total QC Samples
AC	ESATR8	230617JK01	A170233	TEM ISO	Air	8	5	3
AC	EMSL04	230617JK02	041718445	TEM ISO	Air	6	4	2
CV	EMSL32	240917JR01	321723073	TEM ISO	Air	6	5	1
CV	EMSL04	240917CL01	041728459	TEM ISO	Air	6	5	1
					TOTALS	**26**	**19**	**7**

The 26 total asbestos samples validated for OU3 in 2017 consisted of 19 field samples and seven QC samples. The QC samples included four LBs, two RDs, and one RP. No qualifiers were applied to any of the 26 2017 OU3 asbestos samples validated, nor were any bench sheet/EDD discrepancies found.

4.0 Laboratory On-site Audits

On-site audits of all laboratories and the soil preparation facility (SPF) used by EPA for analytical support at the Libby Superfund Site were conducted in 2017. During this period, a total of six on-site audits were performed as related to OU3, including five asbestos laboratory audits and one asbestos SPF audit. **Table 14** lists the audits performed by laboratory/facility, audit type, and date.

Table 14 – 2017 Asbestos Laboratory and Soil Preparation Facility On-site Audits

Laboratory	Location	Audit Type	Audit Date(s)
EMSL Analytical, Inc. (EMSL32)	South Pasadena, CA	Asbestos Laboratory	01/25-26/2017
EMSL Analytical, Inc. (EMSL03)	New York, NY	Asbestos Laboratory	04/10-11/2017
EMSL Analytical, Inc. (EMSL04)	Cinnaminson, NJ	Asbestos Laboratory	04/12-13/2017
ESAT Region 8 (ESATR8)	Golden, CO	Asbestos Laboratory	05/01-02/2017
EMSL Analytical, Inc. (EMSL22)	Denver, CO	Asbestos Laboratory	05/04-05/2017
ESAT Region 8 SPF (ESATR8 SPF)	Troy, Montana	Soil Preparation Facility	07/11/2017

4.1 On-site Audit Process

On-site audits are used by EPA to verify that samples analyzed by their contract facilities are processed in accordance with EPA requirements. Each on-site audit involves the general elements of preparation, on-site support, and report generation, which are modified as needed to fit the type of audit being performed. All 2017 on-audits were two-day audits, with the exception of the evaluation of the SPF facility, which was audited in one day. All of the on-site audits involved both technical and evidentiary assessments, and determinations as to whether the laboratory had adequately addressed deficiencies identified during the previous on-site audit.

Preparation for asbestos laboratory audits typically involves ensuring the on-site audit checklist to be used is updated to reflect the latest methods and modifications required for Libby sample preparation and analysis; coordination with Region 8 to receive the most recent copies of the laboratory's SOPs, Quality Assurance Manual (QAM) and other needed documentation; and coordination with the EPA representative attending the audit with regard to travel logistics. If there are any anticipated problem areas based on prior evaluation of QC/QA data or validation reports, the auditor will discuss these with the EPA member of the Audit Team prior to the audit.

The on-site audit generally starts with an entrance briefing to the laboratory regarding the areas to be evaluated and the anticipated duration of the audit. This is followed by evaluating areas throughout the laboratory to verify adherence to Libby project analysis requirements, the laboratory preparation and analysis SOPs, and adherence to the requirements in the laboratory QAM. The areas typically audited in an asbestos laboratory include: Sample Receipt, Log-in, Storage, and Chain-of-Custody (COC) procedures; Indirect and Direct Preparation of Samples; Transmission Electron Microscopy (TEM) Analysis; Polarized Light Microscopy (PLM) Analysis; Data Management; and Quality Control/Quality Assurance. As part of the QA/QC assessment, the laboratory's internal audit and air monitoring programs are evaluated. All laboratory staff involved with handling, preparing, analyzing, reporting, and performing QC on Libby samples are interviewed. Findings are identified and reported to the laboratory at the exit debriefing.

On-site audit reports detailing the findings are prepared and submitted to EPA typically within 30 days and, following EPA approval, are sent to the laboratories by EPA. Audited laboratories are required to provide corrective action responses to EPA regarding the on-site audit findings. Areas where findings were identified are evaluated during the subsequent on-site audit to determine the degree to which the laboratories have applied corrective action.

The results from the above-listed laboratory and SPF on-site audits performed in 2017 are summarized by the following sections:

- Deficiencies by Laboratory (5 laboratories)
- Laboratory Trends (5 laboratories)
- Deficiencies by Laboratory Process Area (5 laboratories)
- Laboratory Responses (5 laboratories)
- SPF Audits (ESATR8 SPF)
- Laboratory Internal Audits (5 laboratories)
- Air Monitoring (5 laboratories)

4.2 On-site Audit Deficiencies by Laboratory

A total of 10 deficiencies were identified from the five laboratory on-site audits performed in 2017. Deficiencies from the SPF audit are not included in this total because it did not involve the preparation and analysis of asbestos samples. The results from the SPF on-site audit are discussed separately in Section 4.6. For the laboratory audits conducted in 2017, an average of 2.0 deficiencies per audit was observed. The laboratories with the lowest number of on-site audit deficiencies were EMSL03, EMSL04, and ESATR8 with one each, and the laboratory with the highest number of deficiencies was EMSL32 with five. The 2017 Libby OU3 asbestos on-site audit deficiencies by laboratory are provided in **Table 15**.

Table 15 – 2017 Asbestos On-site Audit Deficiencies by Laboratory

Laboratory	Year	Total Deficiencies	Percentage
EMSL32	2017	5	50%
EMSL03	2017	1	10%
EMSL04	2017	1	10%
ESATR8	2017	1	10%
EMSL22	2017	2	20%
	TOTAL	**10**	
	AVERAGE	**2**	

4.3 Deficiency Trends by Laboratory

A deficiency comparison between the 2015 on-site audits and the same laboratories audited in 2017 was performed to determine corrective action trends. Note that no on-site audits of the Troy, MT soil preparation facility (SPF) or asbestos laboratories used by USEPA for analytical support at the OU3 Libby Superfund Site were conducted in 2016. A total of 15 deficiencies were identified in the five asbestos on-site laboratory audits performed during 2015, as compared to the 10 defects observed in the on-site audits of the same five laboratories in 2017 (see **Table 16**). It should be noted that both the 2015 and 2017 on-site audits were full 2-day audits.

Table 16 – 2015 & 2017 On-site Audit Total Defects by Laboratory

	Deficiencies		Change In Defects per Audit	
Laboratory	2015	2017	Increase/(Decrease)	%Increase/(%Decrease)
EMSL32	7	5	(2)	(29%)
EMSL03	2	1	(1)	(50%)
EMSL04	1	1	0	0%
ESATR8	2	1	(1)	(50%)
EMSL22	3	2	(1)	(33%)
TOTALS	**15**	**10**	**(5)**	**(33%)**
AVERAGES	**3.0**	**2.0**	**(1.0)**	**(33%)**

As **Table 16** shows, the average of 2.0 defects per on-site audit in 2017 represents a 33% decrease from the 3.0 average number of defects per on-site audit recorded in 2015. All five laboratories audited in 2015 and again in 2017 showed a neutral or decrease in the number of defects found. This decrease across all Libby OU3 participating laboratories suggests and overall increase in laboratory performance.

During the 2017 on-site audits, QATS personnel evaluated the defects identified in the previous audits to determine whether corrective action had been applied. **Table 17** provides a summary of the degree to which each laboratory addressed the deficiencies from the 2015 on-site audits. For all laboratories, findings from the previous audit were at least partially addressed when reviewed during the on-site audit for the current contract year.

Table 17 – Summary of 2017 Follow-up On-site Audit Deficiencies

Laboratory	Location	2015 Findings (%)			New Deficiencies in 2017
		Addressed	Partially Addressed	Not Addressed	
EMSL32	South Pasadena, CA	(7of 7) 100%	NA	NA	5
EMSL03	New York, NY	(2 of 2) 100%	NA	NA	1
EMSL04	Cinnaminson, NJ	(1 of 1) 100%	NA	NA	1
ESATR8	Golden, CO	(2 of 2) 100%	NA	NA	1
EMSL22	Denver, CO	(3 of 3) 100%	NA	NA	2

Laboratory responses to the deficiencies identified in the 2017 on-site audits are reviewed as received, as described in **Section 4.5 Laboratory Responses**. The reported corrective actions will be evaluated in the next on-site audit cycle, expected to take-place in 2019.

4.4 Deficiencies by Laboratory Process Area

The 10 asbestos on-site audit deficiencies identified in the five on-site laboratory audits performed in 2017 were trended by four laboratory process areas. The laboratory process categories in which the majority of the observed deficiencies occurred included indirect and direct preparation of air filter and dust samples and PLM analysis. Categories with the least frequently occurring deficiencies included TEM analysis and sample receipt, storage, log-in, and chain-of-custody.

Table 18 shows the laboratory process categories evaluated, the number and percentage of deficiencies observed in each of the 2017 on-site audits observed by category.

Table 18 – 2017 On-site Laboratory Audit Deficiencies by Laboratory Process Area

Deficiency	# of Deficiencies	% of Deficiencies
Sample Receipt, Storage, Log-in, and Chain-of-Custody	1	10%
Indirect and Direct Preparation of Air Filter and Dust Samples	3	30%
Transmission Electron Microscopy (TEM) Analysis	1	10%
Polarized Light Microscopy (PLM) Analysis	5	50%
TOTAL	**10**	**100%**

* Areas with no deficiencies found are excluded from the above table.

A summary of the deficiencies by laboratory process category that were observed in the five on-site audits performed in 2017 are as follows:

Sample Receipt, Storage, Log-in, and Chain-of-Custody – The one sample receipt, storage, log-in, and chain-of-custody issue observed during the on-site audits included an out-of-date HEPA hood used in sample receipt procedures (EMSL22).

Indirect and Direct Preparation of Air Filter and Dust Samples – A total of three preparation-related deficiencies from three laboratories were identified during the 2017 on-site audits, as follows:

1. Lack of bubble level for ensuring level filtration apparatus (EMSL04).
2. Lack of housekeeping of hood used for TEM and PCM sample preparation (EMSL22).
3. Lack of guidance on type of preparation to use for possibly overloaded samples (EMSL32).

TEM Analysis – The one TEM analysis issue observed during the on-site audits included Recount Different (RD) analysis for the TEM method not performed at the required frequency (EMSL32).

PLM Analysis – A total of five PLM-related deficiencies from three laboratories were identified during the 2017 on-site audits, as follows:

1. Improper decontamination of equipment between sample slide preparations (EMSL03).
2. Two weights rather than three used for balance calibration (EMSL32).
3. USGS Libby Amphibole (LA) Controlled PE Reference Material (0.2% and 1.0% LA by mass) slides not prepared (EMSL32).
4. Refractive Index (RI) liquids for PLM not calibrated monthly (EMSL32).
5. A stereomicroscope which indicated an exceeded calibration due date (ESATR8).

4.5 Laboratory Responses

EPA requires that laboratories provide responses to on-site audit reports identifying their proposed corrective action to each of the findings. These laboratory responses assist EPA in “closing the loop” on laboratory deficiencies, and help resolve method interpretation issues. Of the on-site audit reports prepared and submitted to EPA for the 2017 on-site audits, laboratory responses have been received from EMSL32, EMSL03, and EMSL04. All laboratory responses included proposed corrective actions for the identified findings, along with objective evidence as applicable. No findings were contested. The laboratory-proposed corrective actions will be verified during the next round of scheduled audits.

The remaining laboratory responses to the deficiencies identified in the 2017 on-site audits for EMSL22 and ESATR8 will be reviewed when received to ensure the laboratories have provided corrective action to adequately address each observed deficiency.

4.6 Soil Preparation Facility (SPF) Audits

In 2017, EPA also performed an on-site audit of the ESATR8 SPF in Troy, MT. In 2017, two deficiencies were identified from the SPF on-site audit as compared to the five deficiencies identified in 2015, which represents a 60% decrease. Note that both the 2015 and 2017 SPF audits were one-day on-site audits. **Table 19** shows the on-site audit deficiencies identified in the 2015 and 2017 SPF on-site audits by five facility process areas. Deficiency reductions were observed in each of the laboratory areas evaluated, as shown in the table below.

Table 19 – 2015 & 2017 SPF On-site Audit Deficiencies by Process Area

Laboratory Area	Deficiencies 2015	Deficiencies 2017	%Increase (%Decrease)
Bulk Drying	1	0	(100%)
Grinding and Splitting	0	0	0%
QC/QA & Health and Safety	2	2	0%
Sample Receiving	0	0	0%
Sieving of Preparation Samples	2	0	(100%)
TOTALS	**5**	**2**	**(60%)**

The 2017 SPF on-site audit identified two deficiencies related to the QA/QC and health and safety evaluation, which are summarized below:

1. An internal quality/process audit was not performed, as required by the QAM, within the last year (Repeat Defect).
2. As of the audit date, documentation that all SPF staff had read and acknowledged the current version of Standard Operating Procedure (SOP) 16-ASB-06.03 prior to the 2016 and 2017 sampling seasons was not available. Note that the deficiency was addressed by SPF staff prior to the submission of the on-site audit report.

During the 2017 on-site audit of the SPF, QATS personnel evaluated the defects identified in the previous 2015 audit to determine whether corrective action had been applied, as summarized in **Table 20** below.

Table 20 – Summary of 2017 Follow-up On-site Audit Deficiencies

Laboratory	Location	2015 Findings (%)			New Deficiencies in 2017
		Addressed	Partially Addressed	Not Addressed	
ESATR8 SPF	Troy, Montana	4 of 5 (80%)	NA	1 of 5 (20%)	1

Of the five findings from the previous on-site audit of the SPF conducted in 2015, the facility had completely addressed four (80%) and did not address one (20%). The finding related to internal audit frequency was not addressed, as described above.

The SPF response to the deficiencies identified in the 2017 on-site audit will be reviewed when received to ensure the facility has provided corrective action to adequately address each observed deficiency.

4.7 Laboratory Internal Audits

As part of the 2017 on-site laboratory audits, the EPA Audit Team evaluated the internal audit program for each of EPA's Libby asbestos support laboratories. All laboratories were found to continue to have active internal audit programs in-place, which involve conducting internal audits of their specific operations on an annual basis using standardized checklists. During the 2017 EPA on-site laboratory audits, the Audit Team reviewed with the laboratory staff any significant findings noted in their internal audit reports. **Table 21** presents the 2017 internal audit history for the five laboratories that provided support to Libby OU3 investigation activities in 2017.

Table 21 – 2017 Laboratory Internal Audit Dates by Laboratory

	Laboratory				
	EMSL03	**EMSL04**	**EMSL22**	**EMSL32**	**ESATR8**
Date:	May 2016	May 2016	November 2016	July 2016	March 2017

4.8 Air Monitoring Samples

During the 2017 on-site laboratory audits, the Audit Team also evaluated whether contract-required environmental contamination monitoring programs were in place at each laboratory that analyzes samples from Libby. The requirements of the laboratory monitoring programs for each laboratory are described in the laboratory-specific Quality Management Plans (QMPs). These include immediate notification by the laboratory QAM to the LC and the QATS contractor of any laboratory contamination monitoring results that are outside of the appropriate acceptance criteria. Air monitoring samples were verified during the on-site audits to have been collected on a quarterly basis in 2017 at the TechLaw, Inc. Region 8 (ESATR8) laboratory and EMSL Laboratories in New York (EMSL03), New Jersey (EMSL04), Denver (EMSL22), and Pasadena (EMSL32). These samples are collected from various locations in each of the laboratories, including the sample receiving, PLM and TEM sample preparation, and the TEM analysis areas. Air monitoring samples at the Troy SPF are collected on a monthly basis. Air monitoring results were reviewed during the 2017 annual on-site audits. No LA structures were observed by the Audit Team.

5.0 Laboratory Mentoring Program

EPA Region 8's mentoring program for laboratories supporting Libby OU3 projects include training, site-specific reference materials, technical discussions, monthly EPA/laboratory calls, electronic data audits, and the use of laboratory modification forms.

To ensure that new laboratories have properly trained staff to perform analysis of Libby site samples, EPA established training programs that allow laboratories and/or analysts who are experienced with the analysis of LA provide training and mentoring to new laboratories prior to the receipt and analysis of Libby field samples. This training program for new laboratories includes a rigorous 2-3 day period of on-site training provided by senior personnel from those laboratories who are highly experienced with the Libby project. Training includes a review of morphological, optical, chemical, and electron diffraction characteristics of LA, as well as training on the project-specific analytical methodology, documentation, and administrative procedures required for the Libby site. No new laboratories were mentored for Libby OU3 during 2016.

For those laboratories and analysts already analyzing samples from the Libby site, the following reference materials, EDD tools, SOPs, laboratory modification, and meeting participation are in place to ensure consistency and continued training:

<u>Site-specific Reference Materials</u>

- TEM - Because LA is not a common form of asbestos, USGS prepared site-specific reference materials using LA collected at the Libby mine site (EPA 2008a), which each laboratory must analyze in order to become familiar with the physical and chemical appearance of LA and establish a reference library of instrument-specific LA EDS spectra.

- PLM - USGS has also prepared site-specific reference materials of LA in soil for use during PLM-VE analyses, which are mounted on slides at concentrations of 0.2% and 1.0% by weight and used to assist in determining visual area estimation of LA levels in soil.

Monthly Technical Discussions

To ensure that all laboratories are aware of technical or procedural issues and requirements, monthly teleconference calls are held between EPA, their contractors, and each of the participating laboratories. These calls cover all aspects of the analytical process, including sample flow, information processing, technical issues, analytical method procedures and development, documentation issues, project-specific laboratory modifications, and pertinent asbestos publications.

Electronic Data Deliverable (EDD) Reporting

Standardized data entry spreadsheets (electronic data deliverables, or EDDs) have been developed specifically for the Libby project to ensure consistency between laboratories in the presentation and submittal of analytical data. In general, a unique Libby-specific EDD was developed for each type of analytical method. Each EDD contains a variety of built-in QC functions that improve the accuracy of data entry and help maintain data integrity.

Laboratory Modification Forms

When changes or revisions are needed to improve or document specifics about analytical methods or procedures used by the Libby laboratory team, these changes are documented using laboratory modification forms, which provide a standardized format for tracking procedural changes in sample analysis, allowing project managers to assess potential impacts on the quality of the data being collected. A list of current, active modifications is provided in **Section 6.0**.

6.0 Laboratory Modifications

Referenced in the QAPPs related to the 2017 AC and CV OU3 investigations, 16 permanent laboratory modifications were current and active in 2017 as presented in **Table 22**. No laboratory modifications were developed or revised in 2017.

Table 22 – 2017 Active Laboratory Modifications

Lab Mod	Effective/ Revision Date	Description
LB-000015B	11/02/2015	PCM and Overloaded Samples
LB-000016H	03/19/2012	TEM by Method ISO 10312
LB-000020D	04/22/2015	TEM Water
LB-000029G	03/21/2016	TEM QC
LB-000031G	06/18/2012	TEM AHERA & ASTM Recording Rules
LB-000040A	01/25/2012	ASTM Method
LB-000055B	11/05/212	Outdoor Ambient Air Monitoring Programs Air Samples
LB-000066E	08/15/2013	Structure photos, spectra, and NaK codes

Table 22 – 2017 Active Laboratory Modifications

Lab Mod	Effective/ Revision Date	Description
LB-000067C	04/01/2013	General TEM recording rules (sketch structures, ND stands for "Not Detected", list of valid values for Structure ID, lab blanks always have LQ-00001 as sample number, Prep Date is when prep starts)
LB-000085A	05/04/2012	TEM Calibrations
LB-000088	02/20/2013	Soil Preparation and PLM SOPs
LB-000091	07/16/2013	Indirect Preparation
LB-000097A	12/17/2014	PLM-VE QC Procedures
LB-000098	03/04/2014	PLM-Grav QC Procedures
LB-0000103	05/18/2015	Multiple PLM Scopes
LB-000105A	09/21/2016	EPA-Libby-2012-11 Ash-specific

7.0 Conclusions and Recommendations

QC Data Evaluated

Field QC

The field QC samples collected for the 2017 OU3 studies included field blanks and lot blanks for TEM. Field QC frequencies and requirements were met in all cases with two lot blanks completed for each of the two investigations conducted in 2017 study and one field blank for each of the five total days of sampling over the two projects. No asbestos structures were observed in any of the field or lot blanks analyzed in 2017, suggesting that no contamination was introduced during the production (lot blanks), collection, preparation, or analysis of these samples.

While the field QC frequencies required by the two sampling projects for OU3 in 2017 were the same, because each OU3 phase typically requires different QC sample processing frequencies based upon the applicable SAP, the QATS Program recommends that field SAPs be read and acknowledged by all field personnel, and that COCs are reviewed to ensure that field QC are collected at the frequencies required by the investigation-specific SAPs.

Laboratory Analysis QC - TEM

<u>TEM QC Frequency</u>

As described in **Section 2.2.1**, the results from all three laboratories combined met the OU3 program-wide TEM QC sample frequency requirements for LB, RS, RD, VA, RP, and ILs described in Laboratory Modification LB-0000029. This requirement was also met in the previous year, which was likely attributed to procedural changes enacted to ensure an appropriate number of QC analyses were performed in 2015, specifically those with frequency requirements of 1.0%. Laboratory Modification LB-000029 was modified (following a QATS Program recommendation) to ensure that adequate QC analyses are performed when less than the number of samples necessary to trigger these analyses are reached.

Nineteen (19) TEM LBs were analyzed by participating laboratories in 2017, with no asbestos structures observed. This suggests that asbestos contamination was not introduced during preparation or analyses of TEM samples. All individual laboratories met the OU3 program frequency requirements for lab blanks without exception. The overall program frequency of LB analyses of 20.4% exceeded the Laboratory Modification LB-000029 frequency requirement of 4.0%.

Laboratory TEM QC Concordance

The 2017 TEM intra-laboratory recount analyses (RS, RD, and VA) presented in **Table 7** fell into the "Good" range described in **Table 6** with the exception of the "Poor" categorization for mineral class (LA vs. NAM) at 0%, with the only sample reporting a NAM structure, having not been confirmed in the QC evaluation. Statistical analysis of the RP results detailed in **Table 9** shows that 100% of the three RP analyses were within the 90% CI established for their evaluation of total and PCMe LA, falling into the "Good" rating category, as established by the program-wide goals.

Overall, the reported results of the five samples which comprised the 2017 TEM inter-laboratory (IL) study presented in **Table 12** fell into the "Good" range described in **Table 6**, with all results matching between laboratories for each sample.

Asbestos Data Validation

In 2017, data validation was performed on 26 of the 137 Libby OU3 samples analyzed. Keeping in-line with the 2016 validation effort, 100% of the 26 Libby OU3 asbestos results for samples validated in 2017 required no qualification.

Bench sheet/EDD comparisons were also conducted on all samples validated in 2017, with none of the sample results validated containing bench sheet/EDD discrepancies. This is an improvement over last year in which three of the 41 samples validated indicated some bench sheet/EDD discrepancy which was considered minor (i.e., typographical errors or omissions in fields), as having no impact on the sample results.

Laboratory On-site Audits

The 2017 on-site laboratory audits consisted of full 2-day audits. A total of 10 audit defects were identified in the five on-site laboratory audits performed in 2017. The deficiencies by laboratory from high to low include: EMSL32 (5), EMSL22 (2), and EMSL03, EMSL04, and ESATR8 (1 each). The laboratory process categories in which the majority of the observed deficiencies for the audits performed in 2017 occurred include: indirect and direct preparation of air filter and dust samples (3 deficiencies) and PLM analysis (5 deficiencies). For the 2017 on-site audits there was a 33% decrease observed in the average number of defects per on-site audit as compared to 2015 for the same five laboratories audited in both 2015 and 2017. Laboratory responses, in the form of proposed corrective actions to the identified deficiencies, were submitted by the laboratories for both the 2015 and 2017 audits. For the laboratory responses received, no findings were contested. The laboratory-proposed corrective actions in response to the 2017 audits will be verified during the next round of scheduled audits.

In 2017, the QATS Program also supported an on-site audit of the Troy SPF in Troy, MT. Two deficiencies were identified in the 2017 Troy SPF on-site audit as compared to the five defects observed at the same facility in 2015, representing a 60% decrease. One of the deficiencies found in the 2017 audit of the facility related to internal audit frequency was considered a "repeat defect."

It is recommended that the on-site audit program continue, with at least biennial full, two-day on-site audits scheduled at the Libby asbestos support laboratories and sample preparation facilities. The QATS Program will use information gathered from the validation process, PLM and TEM Inter-laboratories, and feedback from data users to further enhance the on-site audit process.

8.0 References

APTIM QATS Program, Release of Validated Data Reports – Air Curtain Burner Study (2 Laboratory Jobs) for Task Order 1021 Quality Assurance (QA) Support for RI/FS at the Libby OU3 Asbestos Site, Nevada, 2017.

APTIM QATS Program, Release of Validated Data Reports – Surface Cover Study (2 Laboratory Jobs) for Task Order 1021 Quality Assurance (QA) Support for RI/FS at the Libby OU3 Asbestos Site, Nevada, 2017.

APTIM QATS Program, Summary Asbestos On-Site Audit Report for EMSL Analytical, Inc. (Denver, CO) for Task Order 1019 Quality Assurance (QA) Support for the Libby Asbestos Site, Nevada, 2017.

APTIM QATS Program, Summary Asbestos On-Site Audit Report for EMSL Analytical, Inc. (Cinnaminson, NJ) for Task Order 1019 Quality Assurance (QA) Support for the Libby Asbestos Site, Nevada, 2017.

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APTIM QATS Program, Summary Asbestos On-Site Audit Report for LA Testing/EMSL Analytical, Inc. (Pasadena, CA) for Task Order 1019 Quality Assurance (QA) Support for the Libby Asbestos Site, Nevada, 2017.

APTIM QATS Program, Summary Asbestos On-Site Audit Report for TechLaw, Inc. Region 8 Laboratory (Golden, CO) for Task Order 1019 Quality Assurance (QA) Support for the Libby Asbestos Site, Nevada, 2017.

EPA 2017 Phase 1 Feasibility Study 2017 Treatability Studies: Air Curtain Burner Study – Surface Covers Study, Quality Assurance Project Plan, Operable Unit 3, Libby Asbestos Superfund Site (Revision 0). U.S. Environmental Protection Agency, Region 8. June 2017.

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Nelson W., Applied Life Data Analysis, John Wiley and Sons, New York, 1982.

NIST, Airborne Asbestos Method: Standard Test Method for Verified Analysis of Asbestos by Transmission Electron Microscopy – Version 2.0. National Institute of Standards and Technology, Washington DC. NISTIR 5351, March 1994.

ATTACHMENT B
TEM CONSISTENCY REVIEW AND DATA TRANSFER VERIFICATION REPORTS FOR 2017 TREATABILITY STUDIES

Project/Dataset Description: Libby Asbestos Superfund Site, Operable Unit 3 (OU3) 2017 Treatability Studies – Air and Ash

SUMMARY OF FINDINGS AND DATA QUALITY IMPLICATIONS

A verification of the Libby Asbestos Superfund Site (Site), Operable Unit 3 (OU3) 2017 Treatability Study air and ash analyses was performed. Samples were collected and analyzed in accordance with the governing sampling and analysis plan/quality assurance project plan (SAP/QAPP), *Phase 1 Feasibility Study 2017 Treatability Studies*, Revision 0 (Stantec 2017a) and Revision 1 (Stantec 2017b). Air and ash samples were analyzed by transmission electron microscopy (TEM) in accordance with International Standard Organization (ISO) method 10312:1995(E), *Determination of asbestos fibres-direct-transfer transmission electron microscopy method* (ISO 1995). This verification effort was based on the Libby OU3 project database and the final laboratory reports as provided by the analytical laboratories in basic accordance with standard operating procedure (SOP) EPA-LIBBY-09 (Revision 2), *SOP for Transmission Electron Microscopy Data Review and Data Entry Verification* (EPA 2012).

The governing SAP/QAPP details the requirements for the Air Curtain Burner (ACB) Treatability Study (referred to as the ACB Study) and the Surface Covers Treatability Study (referred to as the Cover Study). The minimum verification frequency specified in the SAP/QAPP is 10%. Due to the low number of analyses in the ACB Study, and because the number of grid openings examined in each analysis was also low (i.e., only four grid openings were examined in each analysis), the Data Verifier elected to verify 100% of the ACB Study samples, rather than 10% as specified in the SAP/QAPP. Thus, all eight air analyses and three ash analyses (one sample with three laboratory replicates) were selected for verification for the ACB Study. For the Cover Study, analyses were selected for verification in accordance with the governing SAP/QAPP; a total of 13 air analyses were selected for verification.

Any issues identified in the verification process were categorized in the following manner:

> **Critical error**: An error identified in a critical data field which resulted in an error in the calculation of the achieved analytical sensitivity, concentration, or structure count. Critical data fields include, but are not limited to, effective area of the filter, number of grid openings examined, area of a grid opening, sample quantity (e.g., mass, volume, area), number of structures observed, and indirect preparation inputs.
>
> **Potential critical error**: An error identified in a critical data field which does not result in an error in the calculation of the achieved analytical sensitivity, concentration, or structure count.
>
> **Non-critical discrepancy**: A discrepancy identified in a non-critical data field that does not impact the calculation of the achieved analytical sensitivity, concentration, or structure count. Non-critical data fields include, but are not limited to, preparation details (e.g., number of grids prepared, prepared by) and analytical details (e.g., analyst name, analysis date).

Data verification includes checking that results have been transferred correctly from the original hand-written, hard copy analytical laboratory documentation to the electronic data deliverable (EDD). Two analytical laboratories utilized a direct data entry process for the TEM EDDs, meaning, instead of recording information by hand on a laboratory benchsheet, information was directly entered in a software application. The software application automatically transferred the data into the Libby-specific EDD spreadsheet. This process eliminates potential issues that may arise during the transfer of data from the hand-written laboratory benchsheet to the EDD. As a result, hand-written benchsheets (which include analytical details and raw structure data) were not included in the laboratory data packages. If available, other types of hand-written laboratory documentation (e.g., structure sketch sheets, indirect preparation records) were used in the verification effort.

Consistency checks were performed for all analyses to ensure that the reported raw structure data were consistent with the analytical method and that applicable analytical SOPs and Libby-specific laboratory method modifications had been followed. Additionally, all calculated values in the EDD were verified based on raw data inputs to confirm the transfer of data from the EDD to the database was performed properly.

ACB Study - Air

No critical errors were identified during this verification effort. One potential critical error was identified in which the preparation method recorded on the benchsheet (indirect) did not match the preparation method entered in the EDD (direct). This has the potential to impact the reported analytical sensitivity if the incorrect preparation method was entered in the EDD. The laboratory confirmed the preparation method entered in the EDD was correct (direct) and corrected the benchsheet accordingly. No non-critical discrepancies were identified during this verification effort.

ACB Study - Ash

No errors or discrepancies were identified during this verification effort.

Cover Study – Air

No errors or discrepancies were identified during this verification effort.

DATA VERIFICATION COORDINATOR REVIEW

The Data Verification Coordinator (DVC) is required to perform a review of a minimum of 5% of the analyses verified to ensure that any potential issues were identified correctly. This resulted in a check of three TEM-ISO analyses, one from each study and media type. No deficiencies were noted.

RECOMMENDATIONS FOR FUTURE REVIEW AND VERIFICATION

There is no need to perform future review or verification efforts for this dataset because the issue discovered during the verification effort was non-critical and has been resolved.

Data Verifier:	Tyler D Miller	***Date:*** 5/10/2018
Data Verification Coordinator:	Natalie Rom	***Date:*** 5/10/18
Verification Data Manager*:	Natalie Rom	***Date:*** 5/10/18

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

- The hand-written benchsheet was updated and re-submitted by the analytical laboratory to the appropriate parties.
- Signatures for the Data Verifier, Data Verification Coordinator, and Verification Data Manager have been added to the verification summary report.

TEM-ISO SELECTION

Lab	Analyst Initials	Number of TEM-ISO Analyses			Number of TEM-ISO Analyses Selected for Review[1]		
		Detect	Non-Detect	Total	Detect	Non-Detect	Total
ACB Study – Air							
EMSL04	PH	2	2	4	2	2	4
ESATR8	ND	0	4	4	0	4	4
	Total	2	6	8	2	6	8
ACB Study – Ash							
EMSL04	WN	3	0	3	3	0	3
	Total	3	0	3	3	0	3
Cover Study – Air							
EMSL04	FC	8	2	10	1	1	2
	PH	3	2	5	1	1	2
	WN	3	4	7	1	1	2
EMSL32	KC	11	6	17	1	1	2
ESATR8	DK	10	9	19	1	2	3
	ND	13	1	14	1	1	2
	Total	48	24	72	6	7	13
	Grand Total	**53**	**30**	**83**	**8**	**9**	**17**

Dataset	Selection	Goal	Actual[2]
ACB Study – Air	Detect	4	4
	Non-detect	4	4
	Total	8	8
ACB Study – Ash	Detect	3	3
	Non-detect	0	0
	Total	3	3
Cover Study - Air	Detect	4	6
	Non-detect	4	7
	Total	8	13
	Grand Total	**19**	**24**

[1] As noted previously, due to the low number of analyses and grid openings examined in the ACB Study, the Data Verifier elected to verify 100% of analyses, rather than the 10% specified in the governing SAP/QAPP. The tables above reflect 100% selection for the ACB Study and 10% selection for the Cover Study.

[2] The actual number of analyses verified in the Cover Study exceeds the goal due to the selection procedures specified in SOP EPA-LIBBY-09. If an analyst has analyzed at least one sample in a category (detect or non-detect), the minimum number of analyses selected is one. This results in more than 10% of total analyses selection for verification.

CONSISTENCY REVIEW RESULTS

Air Curtain Burner – Air

Number of analyses reviewed: 8 of 8 (100% of total analyses selected)
Number of analyses with recording issues identified[3]: 0 (0% of total analyses reviewed)

Air Curtain Burner – Ash

Number of analyses reviewed: 3 of 3 (100% of total analyses selected)
Number of analyses with recording issues identified: 0 (0% of total analyses reviewed)

Cover Study – Air

Number of analyses reviewed: 13 of 13 (100% of total analyses selected)
Number of analyses with recording issues identified: 0 (0% of total analyses reviewed)

DATA TRANSFER RESULTS

Air Curtain Burner – Air

Number of analyses verified: 8 of 8 (100% of total analyses selected[4])
Number of analyses with data transfer issues identified: 1 (12% of total analyses reviewed)

Type of data transfer issues identified:

1 Preparation method was incorrectly recorded on the benchsheet.

Air Curtain Burner – Ash

Number of analyses verified: 3 of 3 (100% of total analyses selected)
Number of analyses with data transfer issues identified: 0 (0% of total analyses reviewed)

Cover Study – Air

Number of analyses verified: 13 of 13 (100% of total analyses selected)
Number of analyses with data transfer issues identified: 0 (0% of total analyses reviewed)

[3] Recording issues are discrepancies associated with the analyst not recording structures in accordance with the analytical method (e.g., structure type, mineral class, structure comments, energy dispersive x-ray analysis [EDXA] observation).
[4] The direct data entry process for the entry of analytical data into the EDD was utilized by two analytical laboratories. Handwritten benchsheets are not available for review, however, other types of hand-written documentation (i.e., structure sketch sheet, preparation sample data sheet) were utilized during the verification effort.

COMMENTS

Attachments 1 and 2 contain the analytical and structure information for the TEM verification effort. Attachment 3 contains the data packages (e.g., benchsheets, preparation worksheets, structure sketch sheets) that were used for this verification effort, including the data verifier's notes.

REFERENCES

EPA (U.S. Environmental Protection Agency). 2012. *Standard Operating Procedure for TEM Data Review and Data Entry Verification*. SOP EPA-LIBBY-09. Produced by CDM Smith for the U.S. Environmental Protection Agency, Region 8. Revision 2 - September.

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

Stantec. 2017a. *Phase 1 Feasibility Study 2017 Treatability Studies, Sampling and Analysis Plan/Quality Assurance Project Plan.* Libby Asbestos Superfund Site, Operable Unit 3. Revision 0 – June.

Stantec. 2017b. *Phase 1 Feasibility Study 2017 Treatability Studies, Sampling and Analysis Plan/Quality Assurance Project Plan.* Libby Asbestos Superfund Site, Operable Unit 3. Revision 1 – August.

ATTACHMENT 1
DATA SUMMARY OF ANALYTICAL AND RESULT INFORMATION - AIR
Libby Asbestos Superfund Site - Operable Unit 3
2017 Air Curtain Burner Study

DVC - 5% Check	Sample Number	Field QC Type	Media	File Revision No	Lab ID	Instrument	Magnification	GO Size	EFA	Air Volume (L)	Receipt Date	Lab Job Number	Lab Sample ID	Number of Grids Prepared	Preparer Name	Preparation Date	Analyst Name	Analysis Date	Preparation Method	Loose Material	Analysis Method	Est Filter Loading (%)	F Factor	Analysis Comments
	AC-00002	Field Sample	Air	0	ESATR8	JEOL JEM-1011 (C24)	5000	0.0103	385	542	6/27/2017	A170233	A170233-02	3	N. DelHierro	6/28/2017	N. DelHierro	6/28/2017	Direct	No	TEM-ISO	2	1	
	AC-00004	Field Sample	Air	0	ESATR8	JEOL JEM-1011 (C24)	5000	0.0103	385	551	6/27/2017	A170233	A170233-04	3	N. DelHierro	6/28/2017	N. DelHierro	6/28/2017	Direct	No	TEM-ISO	5	1	
x-NR	AC-00006	Field Sample	Air	0	ESATR8	JEOL JEM-1011 (C24)	5000	0.0103	385	531	6/27/2017	A170233	A170233-06	3	N. DelHierro	6/28/2017	N. DelHierro	6/28/2017	Direct	No	TEM-ISO	4	1	
	AC-00008	Field Sample	Air	0	ESATR8	JEOL JEM-1011 (C24)	5000	0.0103	385	540	6/27/2017	A170233	A170233-08	3	N. DelHierro	6/28/2017	N. DelHierro	6/28/2017	Direct	No	TEM-ISO	9	1	
	AC-00011	Field Sample	Air	0	EMSL04	JEOL-1200-EX II (04-06)	10000	0.0131	385	540	6/27/2017	041718445	041718445-0002	4	R. Burton	6/27/2017	P. Harrison	6/28/2017	Direct	No	TEM-ISO	3	1	Primary Filter Pore Size (um): 0.8Secondary Filter Pore Size (um):Are prepped grids acceptable for analysis? YesAdditional analysis dates: N/A
	AC-00013	Field Sample	Air	0	EMSL04	JEOL-1200-EX II (04-06)	10000	0.0131	385	531	6/27/2017	041718445	041718445-0004	2	R. Burton	6/27/2017	P. Harrison	6/28/2017	Direct	No	TEM-ISO	3	1	Primary Filter Pore Size (um): 0.8Secondary Filter Pore Size (um):Are prepped grids acceptable for analysis? YesAdditional analysis dates: N/A
	AC-00015	Field Sample	Air	0	EMSL04	JEOL-1200-EX II (04-06)	10000	0.0131	385	540	6/27/2017	041718445	041718445-0006	4	R. Burton	6/27/2017	P. Harrison	6/28/2017	Direct	No	TEM-ISO	5	1	Primary Filter Pore Size (um): 0.8Secondary Filter Pore Size (um):Are prepped grids acceptable for analysis? YesAdditional analysis dates: N/A
	AC-00017	Field Sample	Air	0	EMSL04	JEOL-1200-EX II (04-06)	10000	0.0129	385	536	6/27/2017	041718445	041718445-0008	4	R. Burton	6/27/2017	P. Harrison	6/28/2017	Direct	No	TEM-ISO	5	1	Primary Filter Pore Size (um): 0.8Secondary Filter Pore Size (um):Are prepped grids acceptable for analysis? YesAdditional analysis dates: N/A

Sample Number	Recording Rules			Stopping Rules			Grid Openings Examined	Sensitivity (cc^{-1})	PCME LA		PCME OA		PCME CH		Stopping Rule Achieved	Verifier's Company	Verifier's Name	Verified Date	Verification Comment	Correction Date
	Minimum Aspect Ratio	Minimum Length (μm)	Minimum Width (μm)	Target Sensitivity (cc^{-1})	Max Area Examined (mm^2)	Target N Strucs			Structure Count	Conc. (s/cc)	Structure Count	Conc. (s/cc)	Structure Count	Conc. (s/cc)						
AC-00002	3:1	5	0.25	0.033	0.5	25	4	0.017	0	0	0	0	0	0	Sensitivity	CDM Smith	T. Miller	8/21/2017		
AC-00004	3:1	5	0.25	0.033	0.5	25	4	0.017	0	0	0	0	0	0	Sensitivity	CDM Smith	T. Miller	8/21/2017	The preparation type recorded on the benchsheet is "Indirect", but should be "Direct".	10/2/2017
AC-00006	3:1	5	0.25	0.033	0.5	25	4	0.018	0	0	0	0	0	0	Sensitivity	CDM Smtih	T. Miller	8/21/2017		
AC-00008	3:1	5	0.25	0.033	0.5	25	4	0.017	0	0	0	0	0	0	Sensitivity	CDM Smtih	T. Miller	8/21/2017		
AC-00011	3:1	5	0.25	0.033	0.5	25	4	0.014	0	0	0	0	0	0	Sensitivity	CDM Smith	T. Miller/DDE	8/21/2017		
AC-00013	3:1	5	0.25	0.033	0.5	25	4	0.014	1	0.014	0	0	0	0	Sensitivity	CDM Smith	T. Miller/DDE	8/21/2017		
AC-00015	3:1	5	0.25	0.033	0.5	25	4	0.014	1	0.014	0	0	0	0	Sensitivity	CDM Smith	T. Miller/DDE	8/21/2017		
AC-00017	3:1	5	0.25	0.033	0.5	25	4	0.014	0	0	0	0	0	0	Sensitivity	CDM Smith	T. Miller/DDE	8/21/2017		

Notes:
% = percent
μm = micrometer
ABS = activity-based sampling
cc^{-1} = per cubic centimeter
CH = chrysotile
Conc. = concentration
DDE = direct data entry
DVC = Data Verification Coordinator
EFA = effective filter area
GO = grid opening
ID = identification
ISO = International Organization for Standardization
L = liter
LA = Libby amphibole asbestos
mL = milliliter
mm^2 = square millimeter
OA = other amphibole
PCME = phase contrast microscopy-equivalent
s/cc = structures per cubic centimeter
TEM = transmission electron microscopy

ATTACHMENT 1
DATA SUMMARY OF ANALYTICAL AND RESULT INFORMATION - ASH
Libby Asbestos Superfund Site - Operable Unit 3
2017 Air Curtain Burner Study

DVC - 5% Check	Sample Number	Media	File Revision No	Lab ID	Instrument	Magnification	GO Size	EFA (mm^2)	Sample Mass (g dry weight)	Receipt Date	Lab Job Number	Lab Sample ID	Number Grid Prep	Preparer Name	Preparation Date	Analyst Name	Analysis Date	Preparation Method	Est Filter Loading	Analysis Method	Ashed residue mass (g), total	Ashed residue mass (g), aliquot in dilution	Volume 1 (mL)	Aliquot 1 (mL)	F Factor	Analysis Comments
x-NR	AC-00019	Ash	0	EMSL04	JEM-100CXII (04-05)	19000	0.0128	1338	0.25	6/30/2017	041718876	041718876-0001	4	J. Grillo	7/3/2017	W. Nguyen	7/12/2017	Indirect - Ashed	20	ISO 10312	0.25	0.25	100	2	0.02	Are prepped grids acceptable for analysis? YesAdditional analysis dates: N/A
	AC-00019	Ash	0	EMSL04	JEM-100CXII (04-05)	19000	0.0128	1338	0.25	6/30/2017	041718876	041718876-0001A	4	J. Grillo	7/3/2017	W. Nguyen	7/13/2017	Indirect - Ashed	20	ISO 10312	0.25	0.25	100	2	0.02	Are prepped grids acceptable for analysis? YesAdditional analysis dates: N/A
	AC-00019	Ash	0	EMSL04	JEM-100CXII (04-05)	19000	0.0128	1338	0.25	6/30/2017	041718876	041718876-0001B	4	J. Grillo	7/3/2017	W. Nguyen	7/14/2017	Indirect - Ashed	22	ISO 10312	0.25	0.25	100	2	0.02	Are prepped grids acceptable for analysis? YesAdditional analysis dates: N/A

Lab Sample ID	Recording Rules			Stopping Rules			Grid Openings Examined	Sensitivity	Total LA		PCME LA		Total OA		PCME OA		Total CH		PCME CH		Stopping Rule Achieved	Verifier's Company	Verifier's Name	Verified Date	Verification Comment	Correction Date
	Minimum Aspect Ratio	Minimum Length (μm)	Minimum Width (μm)	Target Sens	Max Area Examined	Target N Strucs			Structure Count	Conc. (s/g)	Structure Count	Conc. (s/g)	Structure Count	Conc. (s/g)	Structure Count	Conc. (s/g)	Structure Count	Conc. (s/g)	Structure Count	Conc. (s/g)						
041718876-0001	3:1	0.5	0	1.0E+07	1	25	4	5.2E+06	3	1.6E+07	0	0	0	0	0	0	0	0	0	0	Sensitivity	CDM Smith	T. Miller/DDE	8/21/2017		
041718876-0001A	3:1	0.5	0	1.0E+07	1	25	4	5.2E+06	3	1.6E+07	0	0	0	0	0	0	0	0	0	0	Sensitivity	CDM Smith	T. Miller/DDE	8/21/2017		
041718876-0001B	3:1	0.5	0	1.0E+07	1	25	4	5.2E+06	3	1.6E+07	0	0	0	0	0	0	0	0	0	0	Sensitivity	CDM Smith	T. Miller/DDE	8/21/2017		

<u>Notes:</u>
μm = micrometer
CH = chrysotile
Conc. = concentration
DDE = direct data entry
DVC = Data Verification Coordinator
EFA = effective filter area
g = gram
GO = grid opening
ID = identification
ISO = International Organization for Standardization
LA = Libby amphibole asbestos
mL = milliliter
mm^2 = square millimeter
OA = other amphibole
PCME = phase contrast microscopy-equivalent
s/g = structures per gram
TEM = transmission electron microscopy

ATTACHMENT 1
DATA SUMMARY OF ANALYTICAL AND RESULT INFORMATION - AIR
Libby Asbestos Superfund Site - Operable Unit 3
2017 Cover Study

DVC - 5% Check	Sample Number	Media	File Revision No	Lab ID	Instrument	Magnification	GO Size	EFA	Air Volume (L)	Receipt Date	Lab Job Number	Lab Sample ID	Number of Grids Prepared	Preparer Name	Preparation Date	Analyst Name	Analysis Date	Preparation Method	Loose Material	Analysis Method	Est Filter Loading (%)	F Factor	Analysis Comments	Recording Rules			Stopping Rules			Grid Openings Examined	Sensitivity (cc^{-1})	PCME LA		PCME OA		PCME CH		Area Examined (mm^2)	Stopping Rule Achieved	Verifier's Company	Verifier's Name	Verified Date	Verification Comment
																								Minimum Aspect Ratio	Minimum Length (µm)	Minimum Width (µm)	Target Sensitivity (cc^{-1})	Max Area Examined (mm^2)	Target N Strucs			Structure Count	Conc. (s/cc)	Structure Count	Conc. (s/cc)	Structure Count	Conc. (s/cc)						
	CV-00010	Air	0	EMSL32	32-04	10000	0.0128	385	60	10/25/2017	321725158	321725158-0010	4	Q. Trieu	10/26/2017	K. Corbin	11/6/2017	Direct	No	TEM-ISO	25	1	Primary Filter Pore Size (um): 0.8Secondary Filter Pore Size (um):Are prepped grids acceptable for analysis? YesAdditional analysis dates: N/A	3:1	5	0.25	0.022	0.65	25	23	0.022	12	0.26	1	0.022	0	0	0.2944	Sensitivity	CDM Smith	T. Miller/DDE	2/1/2018	
	CV-00012	Air	0	EMSL04	JEOL-1200-EX II (04-06)	10000	0.0131	385	60	10/25/2017	041730938	041730938-0001	4	J. Barner	10/25/2017	P. Harrison	11/10/2017	Direct	No	TEM-ISO	2	1	Primary Filter Pore Size (um): 0.8Secondary Filter Pore Size (um):Are prepped grids acceptable for analysis? YesAdditional analysis dates: N/A	3:1	5	0.25	0.022	0.65	25	23	0.021	3	0.064	0	0	0	0	0.3013	Sensitivity	CDM Smith	T. Miller/DDE	2/1/2018	
	CV-00018	Air	0	EMSL04	JEOL-1200-EX II (04-06)	10000	0.0131	385	60	10/25/2017	041730938	041730938-0007	4	J. Barner	10/25/2017	P. Harrison	11/13/2017	Direct	No	TEM-ISO	2	1	Primary Filter Pore Size (um): 0.8Secondary Filter Pore Size (um):Are prepped grids acceptable for analysis? YesAdditional analysis dates:	3:1	5	0.25	0.022	0.65	25	23	0.021	0	0	0	0	0	0	0.3013	Sensitivity	CDM Smith	T. Miller/DDE	2/1/2018	
	CV-00030	Air	0	ESATR8	JEOL JEM-1011 (C24)	5000	0.0103	385	40	10/23/2017	A170529	A170529-09	3	N. DelHierro	10/24/2017	D. Kent	10/27/2017	Direct	No	TEM-ISO	3	1		3:1	5	0.25	0.06	0.4	25	16	0.058	0	0	0	0	0	0	0.1648	Sensitivity	CDM Smith	T. Miller	2/1/2018	
	CV-00058	Air	0	ESATR8	JEOL JEM-1011 (C24)	5000	0.0103	385	40	9/29/2017	A170500	A170500-01	3	D. Kent	10/3/2017	D. Kent	10/4/2017	Direct	No	TEM-ISO	3	1	Also analyzed on 10/5/2017.	3:1	5	0.25	0.011	1.67	25	88	0.011	5	0.053	0	0	0	0	0.9064	Sensitivity	CDM Smith	T. Miller	1/31/2018	
x-NR	CV-00062	Air	1	ESATR8	JEOL JEM-1011 (C24)	5000	0.0103	385	40	9/29/2017	A170500	A170500-05	3	D. Kent	10/3/2017	N. Delhierro	10/6/2017	Direct	No	TEM-ISO	4	1	Also analyzed on 10/9/2017. For C1 EDD changed EDS field for structure 10 from null to 1.	3:1	5	0.25	0.011	1.67	25	85	0.011	15	0.16	0	0	0	0	0.8755	Sensitivity	CDM Smith	T. Miller	2/1/2018	
	CV-00068	Air	0	EMSL04	JEOL-100CXII (04-05)	10000	0.0129	385	40	9/29/2017	041728469	041728469-0001	4	J. Barner	9/29/2017	W. Nguyen	10/2/2017	Direct	No	TEM-ISO	2	1	Primary Filter Pore Size (um): 0.8Secondary Filter Pore Size (um):Are prepped grids acceptable for analysis? YesAdditional analysis dates: N/A	3:1	5	0.25	0.011	1.67	25	68	0.011	2	0.022	0	0	0	0	0.8772	Sensitivity	CDM Smith	T. Miller/DDE	2/1/2018	
	CV-00072	Air	1	EMSL04	JEOL 100 CXII (04-01)	10000	0.0129	385	40	9/29/2017	041728469	041728469-0005	4	J. Barner	9/29/2017	F. Craig	10/4/2017	Direct	No	TEM-ISO	1	1	Primary Filter Pore Size (um): 0.8Secondary Filter Pore Size (um):Are prepped grids acceptable for analysis? YesAdditional analysis dates: 10/11/17C1 on 10/11/2017 to add analysis of 5 additional grid openings.	3:1	5	0.25	0.011	1.67	25	68	0.011	8	0.088	0	0	0	0	0.8772	Sensitivity	CDM Smith	T. Miller/DDE	2/1/2018	
	CV-00088	Air	0	ESATR8	JEOL JEM-1011 (C24)	5000	0.0103	385	60	11/28/2017	A170569	A170569-03	3	D. Kent	11/29/2017	N. DelHierro	12/8/2017	Direct	No	TEM-ISO	3	1		3:1	5	0.25	0.022	0.65	25	29	0.021	0	0	0	0	0	0	0.2987	Sensitivity	CDM Smith	T. Miller	2/1/2018	
	CV-00100	Air	0	EMSL04	JEOL 100 CXII (04-01)	10000	0.0129	385	40	11/29/2017	041734167	041734167-0005	4	J. Barner	11/29/2017	F. Craig	12/1/2017	Direct	No	TEM-ISO	1	1	Primary Filter Pore Size (um): 0.8Secondary Filter Pore Size (um):Are prepped grids acceptable for analysis? YesAdditional analysis dates: N/A	3:1	5	0.25	0.06	0.4	25	13	0.057	0	0	0	0	0	0	0.1677	Sensitivity	CDM Smith	T. Miller/DDE	2/1/2018	
	CV-00106	Air	0	EMSL32	32-04	10000	0.0129	385	40	11/29/2017	321727715	321727715-0003	4	F. Liang	11/29/2017	K. Corbin	11/30/2017	Direct	No	TEM-ISO	2	1	Primary Filter Pore Size (um): 0.8Secondary Filter Pore Size (um):Are prepped grids acceptable for analysis? YesAdditional analysis dates: N/A	3:1	5	0.25	0.06	0.4	25	14	0.053	0	0	0	0	0	0	0.1806	Sensitivity	CDM Smith	T. Miller/DDE	2/1/2018	
	CV-00118	Air	0	ESATR8	JEOL JEM-1011 (C24)	5000	0.0103	385	60	10/23/2017	A170531	A170531-07	3	N. DelHierro	10/24/2017	D. Kent	11/3/2017	Direct	No	TEM-ISO	5	1		3:1	5	0.25	0.022	0.65	25	30	0.021	0	0	0	0	0	0	0.309	Sensitivity	CDM Smith	T. Miller	2/1/2018	
	CV-00138	Air	0	EMSL04	JEOL-1200EX (04-03)	10000	0.0131	385	40	10/25/2017	041730929	041730929-0007	4	J. Barner	10/25/2017	W. Nguyen	10/26/2017	Direct	No	TEM-ISO	3	1	Primary Filter Pore Size (um): 0.8Secondary Filter Pore Size (um):Are prepped grids acceptable for analysis? YesAdditional analysis dates: N/A	3:1	5	0.25	0.06	0.4	25	13	0.057	0	0	0	0	0	0	0.1703	Sensitivity	CDM Smith	T. Miller/DDE	2/1/2018	

Notes:
% = percent
µm = micrometer
ABS = activity-based sampling
cc^{-1} = per cubic centimeter
EFA = effective filter area
GO = grid opening
ID = identification
ISO = International Organization for Standardization
L = liter
mL = milliliter
mm^2 = square millimeter
s/cc = structures per cubic centimeter
TEM = transmission electron microscopy

ATTACHMENT 2
DATA SUMMARY OF STRUCTURE INFORMATION
Libby Asbestos Superfund Site - Operable Unit 3
2017 Air Curtain Burner Study

Sample Number	Lab Sample ID	Structure ID	Row Index	Grid	Grid Opening	Structure Type	Primary	Total	Length (µm)	Width (µm)	Aspect Ratio	Mineral Class	Structure Identification	Sketch	Photo	EDS	Structure Comment	Media Type	Verifier's Company	Verifier's Name	Date Verified	Verification Comment	DVC - 5%
AC-00002	A170233-02	291774	1	A1	E3-3	ND												Air	CDM Smtih	T. Miller	8/21/2017		
AC-00002	A170233-02	291775	2	A1	G2-3	ND												Air	CDM Smtih	T. Miller	8/21/2017		
AC-00002	A170233-02	291776	3	B1	F3-3	ND												Air	CDM Smtih	T. Miller	8/21/2017		
AC-00002	A170233-02	291777	4	B1	H4-1	ND												Air	CDM Smtih	T. Miller	8/21/2017		
AC-00004	A170233-04	291618	1	A2	H4-4	ND												Air	CDM Smtih	T. Miller	8/21/2017		
AC-00004	A170233-04	291619	2	A2	G3-6	ND												Air	CDM Smtih	T. Miller	8/21/2017		
AC-00004	A170233-04	291620	3	B2	C4-1	ND												Air	CDM Smtih	T. Miller	8/21/2017		
AC-00004	A170233-04	291621	4	B2	F5-6	ND												Air	CDM Smtih	T. Miller	8/21/2017		
AC-00006	A170233-06	291622	1	B3	C5-1	ND												Air	CDM Smtih	T. Miller	8/21/2017		x-NR
AC-00006	A170233-06	291623	2	B3	G3-3	ND												Air	CDM Smtih	T. Miller	8/21/2017		x-NR
AC-00006	A170233-06	291624	3	C3	G4-4	ND												Air	CDM Smtih	T. Miller	8/21/2017		x-NR
AC-00006	A170233-06	291625	4	C3	E2-6	ND												Air	CDM Smtih	T. Miller	8/21/2017		x-NR
AC-00008	A170233-08	291630	1	B4	B5-4	ND												Air	CDM Smtih	T. Miller	8/21/2017		
AC-00008	A170233-08	291631	2	B4	F5-3	ND												Air	CDM Smtih	T. Miller	8/21/2017		
AC-00008	A170233-08	291632	3	A5	K5-3	ND												Air	CDM Smtih	T. Miller	8/21/2017		
AC-00008	A170233-08	291633	4	A5	G4-1	ND												Air	CDM Smtih	T. Miller	8/21/2017		
AC-00011	041718445-0002	291746	1	P1	J6	ND												Air	CDM Smith	T. Miller / DDE	8/21/2017		
AC-00011	041718445-0002	291747	2	P1	F6	ND												Air	CDM Smith	T. Miller / DDE	8/21/2017		
AC-00011	041718445-0002	291748	3	P2	C6	ND												Air	CDM Smith	T. Miller / DDE	8/21/2017		
AC-00011	041718445-0002	291749	4	P2	G6	ND												Air	CDM Smith	T. Miller / DDE	8/21/2017		
AC-00013	041718445-0004	291750	1	P5	A10	F	1	1	7.1	1.3	5.4615385	LA	ADX	1	1	1	NaK, WRTA; MG_144, MG_145	Air	CDM Smith	T. Miller / DDE	8/21/2017		
AC-00013	041718445-0004	291751	2	P5	E7	ND												Air	CDM Smith	T. Miller / DDE	8/21/2017		
AC-00013	041718445-0004	291752	3	P7	C8	ND												Air	CDM Smith	T. Miller / DDE	8/21/2017		
AC-00013	041718445-0004	291753	4	P7	H4	ND												Air	CDM Smith	T. Miller / DDE	8/21/2017		
AC-00015	041718445-0006	291754	1	Q1	J5	ND												Air	CDM Smith	T. Miller / DDE	8/21/2017		
AC-00015	041718445-0006	291755	2	Q1	D6	F	1	1	18.4	0.5	36.8	LA	ADX	1	1	1	NaK, WRTA; MG_146, MG_147, XG	Air	CDM Smith	T. Miller / DDE	8/21/2017		
AC-00015	041718445-0006	291756	3	Q2	H5	ND												Air	CDM Smith	T. Miller / DDE	8/21/2017		
AC-00015	041718445-0006	291757	4	Q2	C6	ND												Air	CDM Smith	T. Miller / DDE	8/21/2017		
AC-00017	041718445-0008	291762	1	Q5	G4	ND												Air	CDM Smith	T. Miller / DDE	8/21/2017		
AC-00017	041718445-0008	291763	2	Q5	C6	ND												Air	CDM Smith	T. Miller / DDE	8/21/2017		
AC-00017	041718445-0008	291764	3	Q6	C6	ND												Air	CDM Smith	T. Miller / DDE	8/21/2017		
AC-00017	041718445-0008	291765	4	Q6	H6	ND												Air	CDM Smith	T. Miller / DDE	8/21/2017		
AC-00019	041718876-0001	291791	1	F1	D5	F	1	1	2.3	0.31	7.4193548	LA	ADX	1	1	1	XK, WRTA; MG_415, MG_416	Ash	CDM Smith	T. Miller / DDE	8/21/2017		x-NR
AC-00019	041718876-0001	291792	2	F1	D5	F	2	2	4.6	0.12	38.333333	LA	ADX	1	1	1	XX, WRTA; MG_417, MG_418	Ash	CDM Smith	T. Miller / DDE	8/21/2017		x-NR
AC-00019	041718876-0001	291793	3	F1	A4	ND												Ash	CDM Smith	T. Miller / DDE	8/21/2017		x-NR
AC-00019	041718876-0001	291794	4	F2	D5	F	3	3	2.6	0.5	5.2	LA	ADX	1	1	1	XX, AC; MG_419, MG_420	Ash	CDM Smith	T. Miller / DDE	8/21/2017		x-NR
AC-00019	041718876-0001	291795	5	F2	I6	ND												Ash	CDM Smith	T. Miller / DDE	8/21/2017		x-NR
AC-00019	041718876-0001A	291796	1	G1	G4	F	0	0	2.5	0.24	10.416667	NAM	ADX	1	1	1	; MG_424, MG_425	Ash	CDM Smith	T. Miller / DDE	8/21/2017		
AC-00019	041718876-0001A	291797	2	G1	G4	F	1	1	3.2	0.4	8	LA	ADX	1	1	1	XK, WRTA; MG_426, MG_427	Ash	CDM Smith	T. Miller / DDE	8/21/2017		
AC-00019	041718876-0001A	291798	3	G1	C6	MD10	2											Ash	CDM Smith	T. Miller / DDE	8/21/2017		
AC-00019	041718876-0001A	291799	4	G1	C6	MF		2	1.95	0.25	7.8	LA	ADX	1	1	1	XX, AC; MG_428, MG_429	Ash	CDM Smith	T. Miller / DDE	8/21/2017		
AC-00019	041718876-0001A	291800	5	G2	D5	ND												Ash	CDM Smith	T. Miller / DDE	8/21/2017		
AC-00019	041718876-0001A	291801	6	G2	I6	F	3	3	4.2	0.46	9.1304348	LA	ADX	1	1	1	XX, AC; MG_430, MG_431	Ash	CDM Smith	T. Miller / DDE	8/21/2017		
AC-00019	041718876-0001B	291802	1	H1	H3	F	1	1	1.47	0.15	9.8	LA	ADX	1	1	1	XX, WRTA; MG_434, MG_435	Ash	CDM Smith	T. Miller / DDE	8/21/2017		
AC-00019	041718876-0001B	291803	2	H1	C3	F	2	2	2	0.26	7.6923077	LA	ADX	1	1	1	XX, AC; MG_436, MG_437	Ash	CDM Smith	T. Miller / DDE	8/21/2017		
AC-00019	041718876-0001B	291804	3	H2	H5	F	3	3	3.03	0.25	12.12	LA	ADX	1	1	1	NaX, WRTA; MG_438, MG_439	Ash	CDM Smith	T. Miller / DDE	8/21/2017		
AC-00019	041718876-0001B	291805	4	H2	H5	F	0	0	5	0.45	11.111111	NAM	ADX	1	1	1	; MG_441, MG_442	Ash	CDM Smith	T. Miller / DDE	8/21/2017		
AC-00019	041718876-0001B	291806	5	H2	C5	ND												Ash	CDM Smith	T. Miller / DDE	8/21/2017		

Notes:
µm = micrometer
ABS = activity-based sampling
DVC = Data Verification Coordinator
EDS = energy dispersive spectroscopy
ID = identification
LA = Libby amphibole asbestos
NAM = non-asbestos material
OA = other amphibole

ATTACHMENT 2
DATA SUMMARY OF STRUCTURE INFORMATION - AIR
Libby Asbestos Superfund Site - Operable Unit 3
2017 Cover Study

Sample Number	Lab Sample ID	Structure ID	Row Index	Grid	Grid Opening	Structure Type	Primary	Total	Length (µm)	Width (µm)	Aspect Ratio	Mineral Class	Mineral Description	Structure Identification	Sketch	Photo	EDS	Structure Comment	Verifier's Company	Verifier's Name	Date Verified	Verification Comment	Correction Date	DVC - 5%
CV-00068	041728469-0001	292774	1	I1	D6	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292775	2	I1	D8	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292776	3	I1	D10	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292777	4	I1	E7	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292778	5	I1	E9	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292779	6	I1	F6	F	1	1	11.5	1	11.5	LA		ADX	1	1	1	NaK, WRTA; MG_539, 540	CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292780	7	I1	F8	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292781	8	I1	F10	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292782	9	I1	G5	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292783	10	I1	G7	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292784	11	I1	G9	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292785	12	I1	H2	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292786	13	I1	H4	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292787	14	I1	H6	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292788	15	I1	H8	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292789	16	I1	H10	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292790	17	I1	I1	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292791	18	I1	I3	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292792	19	I1	I5	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292793	20	I1	I7	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292794	21	I1	I9	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292795	22	I2	A1	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292796	23	I2	A3	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292797	24	I2	A5	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292798	25	I2	A7	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292799	26	I2	A9	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292800	27	I2	B2	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292801	28	I2	B4	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292802	29	I2	B6	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292803	30	I2	B8	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292804	31	I2	C1	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292805	32	I2	C3	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292806	33	I2	C5	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292807	34	I2	C7	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292808	35	I2	D2	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292809	36	I2	D4	F	2	2	12.65	0.78	16.217949	LA		ADX	1	1	1	NaK, WRTA; MG_541, 542	CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292810	37	I2	D6	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292811	38	I2	D8	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292812	39	I2	I2	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292813	40	I2	I4	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292814	41	I2	I6	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292815	42	I2	I8	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292816	43	I2	J1	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292817	44	I2	J3	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292818	45	I2	J5	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292819	46	I2	J7	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292820	47	I3	C10	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292821	48	I3	C8	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292822	49	I3	C6	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292823	50	I3	C4	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292824	51	I3	B9	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292825	52	I3	B7	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292826	53	I3	B5	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292827	54	I3	B3	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292828	55	I4	J8	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292829	56	I4	J6	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292830	57	I4	I9	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292831	58	I4	I7	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292832	59	I4	H10	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292833	60	I4	H8	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292834	61	I4	H6	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292835	62	I4	H4	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292836	63	I4	G9	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292837	64	I4	G7	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292838	65	I4	G5	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292839	66	I4	G3	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292840	67	I4	C7	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00068	041728469-0001	292841	68	I4	C5	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	292980	1	J2	I3	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	292981	2	J2	I5	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	292982	3	J2	I7	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	292983	4	J2	I9	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	292984	5	J2	H10	F	1	1	26.8	2.86	9.3706294	LA		ADX	1		1	NaK, WRTA	CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	292985	6	J2	H8	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	292986	7	J2	H6	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	292987	8	J2	H4	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	292988	9	J2	H2	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	292989	10	J2	F10	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	292990	11	J2	F8	F	2	2	24.4	1.32	18.484848	LA		ADX	1	1	1	NaK, WRTA; 1027D	CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	292991	12	J2	F6	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	292992	13	J2	F4	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	292993	14	J2	F2	CD32	3												CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	292994	15	J2	F2	CB		3	20.4	5.75	3.5478261	LA		ADX	1	1	1	XX, WRTA; 1029D	CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	292995	16	J2	F2	CR11		4	6.9	0.6	11.5	LA		ADX	1			NaK, WRTA	CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	292996	17	J2	F2	CR10		0	2.9	0.36	8.0555556	LA		ADX	1				CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	292997	18	J2	E1	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	292998	19	J2	E3	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	292999	20	J2	E5	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	293000	21	J2	E7	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	293001	22	J2	E9	MD21	4												CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	293002	23	J2	E9	MFO		5	8.1	0.48	16.875	LA		ADX	1		1	NaK, WRTA	CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	293003	24	J2	E9	MFO		0	2.9	0.96	3.0208333	LA		ADX	1				CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	293004	25	J2	D10	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	293005	26	J2	D8	F	5	6	7.9	1.8	4.3888889	LA		ADX	1		1	NaK, WRTA	CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	293006	27	J2	D6	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	293007	28	J2	D4	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	293008	29	J2	D2	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	293009	30	J2	C1	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	293010	31	J2	C3	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	293011	32	J2	C5	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	293012	33	J2	C7	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	293013	34	J2	C9	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	293014	35	J3	I1	F	6	7	14.9	2.38	6.2605042	LA		ADX	1			NaK, WRTA	CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	293015	36	J3	I3	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	293016	37	J3	I5	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	293017	38	J3	I7	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	293018	39	J3	H8	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	293019	40	J3	H6	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	293020	41	J3	H4	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	293021	42	J3	H2	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	293022	43	J3	G1	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	293023	44	J3	G3	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	293024	45	J3	G5	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	293025	46	J3	G7	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	293026	47	J3	G9	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	293027	48	J3	F10	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	293028	49	J3	F8	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	293029	50	J3	F6	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	293030	51	J3	F4	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	293031	52	J3	F2	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	293032	53	J3	E1	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	293033	54	J3	E3	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	293034	55	J3	E5	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	293035	56	J3	E7	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	293036	57	J3	D10	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	293037	58	J3	D8	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	293038	59	J3	D6	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	293039	60	J3	D4	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	293040	61	J3	D2	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	293041	62	J3	C1	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	293042	63	J3	C3	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	293043	64	J3	C5	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	293044	65	J3	C7	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	293045	66	J3	B6	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	293046	67	J3	B4	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	293047	68	J3	B2	MD22	7												CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	293048	69	J3	B2	MF		8	14.9	1.44	10.347222	LA		ADX	1			NaK, WRTA	CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	293049	70	J3	B2	MFO		0	33.3	0.36	92.5	LA		ADX	1			; XNCGBLD	CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	293050	71	J1	D2	ND												; Additional analysis completed on 1	CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	293051	72	J1	D4	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	293052	73	J1	D6	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	293053	74	J1	D8	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00072	041728469-0005	293054	75	J1	D10	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00138	041730929-0007	294006	1	E5	H9	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00138	041730929-0007	294007	2	E5	H7	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00138	041730929-0007	294008	3	E5	H5	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00138	041730929-0007	294009	4	E5	B8	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00138	041730929-0007	294010	5	E5	B6	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00138	041730929-0007	294011	6	E6	E3	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00138	041730929-0007	294012	7	E6	E5	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00138	041730929-0007	294013	8	E6	H4	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00138	041730929-0007	294014	9	E6	H6	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00138	041730929-0007	294015	10	E6	H8	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00138	041730929-0007	294016	11	E7	B5	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00138	041730929-0007	294017	12	E7	B7	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00138	041730929-0007	294018	13	E7	I6	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00012	041730938-0001	294611	1	G2	A1	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00012	041730938-0001	294612	2	G2	A3	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00012	041730938-0001	294613	3	G2	B5	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00012	041730938-0001	294614	4	G2	C3	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00012	041730938-0001	294615	5	G2	C1	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00012	041730938-0001	294616	6	G2	D6	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00012	041730938-0001	294617	7	G2	E4	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00012	041730938-0001	294618	8	G2	E1	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00012	041730938-0001	294619	9	G2	F7	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00012	041730938-0001	294620	10	G2	G3	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00012	041730938-0001	294621	11	G2	H7	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00012	041730938-0001	294622	12	G2	I3	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00012	041730938-0001	294623	13	G2	J7	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00012	041730938-0001	294624	14	G3	J4	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00012	041730938-0001	294625	15	G3	I10	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00012	041730938-0001	294626	16	G3	H7	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00012	041730938-0001	294627	17	G3	G10	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00012	041730938-0001	294628	18	G3	F9	CD22	1												CDM Smith	T. Miller/DDE	2/1/2018			
CV-00012	041730938-0001	294629	19	G3	F9	CF		1	8.2	1	8.2	LA		ADX	1			NaK, WRTA	CDM Smith	T. Miller/DDE	2/1/2018			

ATTACHMENT 2
DATA SUMMARY OF STRUCTURE INFORMATION - AIR
Libby Asbestos Superfund Site - Operable Unit 3
2017 Cover Study

Sample Number	Lab Sample ID	Structure ID	Row Index	Grid	Grid Opening	Structure Type	Primary	Total	Length (µm)	Width (µm)	Aspect Ratio	Mineral Class	Mineral Description	Structure Identification	Sketch	Photo	EDS	Structure Comment	Verifier's Company	Verifier's Name	Date Verified	Verification Comment	Correction Date	DVC - 5%
CV-00012	041730938-0001	294630	20	G3	F9	CF		2	7.1	1.1	6.4545455	LA		ADX	1	1	1	NaK, WRTA; MG_215	CDM Smith	T. Miller/DDE	2/1/2018			
CV-00012	041730938-0001	294631	21	G3	E5	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00012	041730938-0001	294632	22	G3	D3	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00012	041730938-0001	294633	23	G3	C7	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00012	041730938-0001	294634	24	G3	B5	F	2	3	17.6	1.3	13.538462	LA		ADX	1			NaK, WRTA; Possible clevage fragmer	CDM Smith	T. Miller/DDE	2/1/2018			
CV-00012	041730938-0001	294635	25	G3	A8	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00018	041730938-0007	294692	1	H5	A7	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00018	041730938-0007	294693	2	H5	B4	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00018	041730938-0007	294694	3	H5	C9	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00018	041730938-0007	294695	4	H5	D7	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00018	041730938-0007	294696	5	H5	D5	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00018	041730938-0007	294697	6	H5	E2	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00018	041730938-0007	294698	7	H5	F4	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00018	041730938-0007	294699	8	H5	F9	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00018	041730938-0007	294700	9	H5	G7	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00018	041730938-0007	294701	10	H5	G2	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00018	041730938-0007	294702	11	H5	H4	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00018	041730938-0007	294703	12	H5	I6	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00018	041730938-0007	294704	13	H5	J4	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00018	041730938-0007	294705	14	H6	A5	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00018	041730938-0007	294706	15	H6	B7	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00018	041730938-0007	294707	16	H6	C4	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00018	041730938-0007	294708	17	H6	D7	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00018	041730938-0007	294709	18	H6	E9	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00018	041730938-0007	294710	19	H6	F7	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00018	041730938-0007	294711	20	H6	G10	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00018	041730938-0007	294712	21	H6	H7	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00018	041730938-0007	294713	22	H6	I10	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00018	041730938-0007	294714	23	H6	J7	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00100	041734167-0005	295013	1	N2	B9	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00100	041734167-0005	295014	2	N2	C6	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00100	041734167-0005	295015	3	N2	D8	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00100	041734167-0005	295016	4	N2	E5	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00100	041734167-0005	295017	5	N2	F10	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00100	041734167-0005	295018	6	N2	I8	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00100	041734167-0005	295019	7	N2	H5	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00100	041734167-0005	295020	8	N3	B2	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00100	041734167-0005	295021	9	N3	C5	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00100	041734167-0005	295022	10	N3	E3	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00100	041734167-0005	295023	11	N3	G6	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00100	041734167-0005	295024	12	N3	I5	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00100	041734167-0005	295025	13	N3	H3	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00010	321725158-0010	294389	1	G1	B3	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00010	321725158-0010	294390	2	G1	B5	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00010	321725158-0010	294391	3	G1	B7	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00010	321725158-0010	294392	4	G1	B9	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00010	321725158-0010	294393	5	G1	C8	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00010	321725158-0010	294394	6	G1	C6	MD11	1												CDM Smith	T. Miller/DDE	2/1/2018			
CV-00010	321725158-0010	294395	7	G1	C6	MF		1	21.5	1	21.5	LA		ADX	1	1	1	NaK, WRTA	CDM Smith	T. Miller/DDE	2/1/2018			
CV-00010	321725158-0010	294396	8	G1	C4	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00010	321725158-0010	294397	9	G1	C2	MD11	2												CDM Smith	T. Miller/DDE	2/1/2018			
CV-00010	321725158-0010	294398	10	G1	C2	MF		2	5.1	0.5	10.2	LA		ADX	1		1	NaK, WRTA	CDM Smith	T. Miller/DDE	2/1/2018			
CV-00010	321725158-0010	294399	11	G1	C2	MD11	3												CDM Smith	T. Miller/DDE	2/1/2018			
CV-00010	321725158-0010	294400	12	G1	C2	MF		3	5.4	0.9	6	LA		ADX	1		1	NaK, WRTA	CDM Smith	T. Miller/DDE	2/1/2018			
CV-00010	321725158-0010	294401	13	G1	D3	F	4	4	8	0.8	10	LA		ADX	1		1	NaX, WRTA	CDM Smith	T. Miller/DDE	2/1/2018			
CV-00010	321725158-0010	294402	14	G1	D5	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00010	321725158-0010	294403	15	G1	D7	MD11	5												CDM Smith	T. Miller/DDE	2/1/2018			
CV-00010	321725158-0010	294404	16	G1	D7	MF		5	22	0.6	36.666667	LA		ADX	1		1	NaK, WRTA	CDM Smith	T. Miller/DDE	2/1/2018			
CV-00010	321725158-0010	294405	17	G1	D7	F	0	0	20	0.3	66.666667	LA		ADX	1			; XNCGBLD	CDM Smith	T. Miller/DDE	2/1/2018			
CV-00010	321725158-0010	294406	18	G1	D7	F	6	6	9	0.6	15	LA		ADX	1			NaK, WRTA	CDM Smith	T. Miller/DDE	2/1/2018			
CV-00010	321725158-0010	294407	19	G1	D9	MD11	7												CDM Smith	T. Miller/DDE	2/1/2018			
CV-00010	321725158-0010	294408	20	G1	D9	MF		7	16	1	16	LA		ADX	1			NaK, WRTA	CDM Smith	T. Miller/DDE	2/1/2018			
CV-00010	321725158-0010	294409	21	G1	D9	F	8	8	15	2.2	6.8181818	LA		ADX	1			NaK, WRTA	CDM Smith	T. Miller/DDE	2/1/2018			
CV-00010	321725158-0010	294410	22	G1	E8	MD11	0												CDM Smith	T. Miller/DDE	2/1/2018			
CV-00010	321725158-0010	294411	23	G1	E8	MF		0	31	1.4	22.142857	LA		ADX	1			; XNCGBLD	CDM Smith	T. Miller/DDE	2/1/2018			
CV-00010	321725158-0010	294412	24	G2	B2	F	0	0	20	0.5	40	LA		ADX	1			; XNCGBLD	CDM Smith	T. Miller/DDE	2/1/2018			
CV-00010	321725158-0010	294413	25	G2	B4	F	9	9	7	0.5	14	LA		ADX	1			NaK, WRTA	CDM Smith	T. Miller/DDE	2/1/2018			
CV-00010	321725158-0010	294414	26	G2	B6	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00010	321725158-0010	294415	27	G2	B8	F	10	10	17	0.8	21.25	LA		ADX	1			NaK, WRTA; XGBLD	CDM Smith	T. Miller/DDE	2/1/2018			
CV-00010	321725158-0010	294416	28	G2	B8	F	11	11	21	1.1	19.090909	OA		ADX	1			NaX, NR	CDM Smith	T. Miller/DDE	2/1/2018			
CV-00010	321725158-0010	294417	29	G2	C9	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00010	321725158-0010	294418	30	G2	C7	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00010	321725158-0010	294419	31	G2	C5	F	12	12	17.5	1.2	14.583333	LA		ADX	1			NaK, WRTA	CDM Smith	T. Miller/DDE	2/1/2018			
CV-00010	321725158-0010	294420	32	G2	C3	MD11	13												CDM Smith	T. Miller/DDE	2/1/2018			
CV-00010	321725158-0010	294421	33	G2	C3	MF		13	12.2	1.2	10.166667	LA		ADX	1			XK, WRTA	CDM Smith	T. Miller/DDE	2/1/2018			
CV-00010	321725158-0010	294422	34	G2	D2	F	0	0	39	1	39	LA		ADX	1			; XNCGB	CDM Smith	T. Miller/DDE	2/1/2018			
CV-00010	321725158-0010	294423	35	G2	D4	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00106	321727715-0003	295047	1	R5	J2	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00106	321727715-0003	295048	2	R5	J4	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00106	321727715-0003	295049	3	R5	J6	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00106	321727715-0003	295050	4	R5	J8	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00106	321727715-0003	295051	5	R5	I9	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00106	321727715-0003	295052	6	R5	I7	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00106	321727715-0003	295053	7	R5	I5	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00106	321727715-0003	295054	8	R6	C3	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00106	321727715-0003	295055	9	R6	C5	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00106	321727715-0003	295056	10	R6	C7	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00106	321727715-0003	295057	11	R6	C9	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00106	321727715-0003	295058	12	R6	D8	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00106	321727715-0003	295059	13	R6	D6	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00106	321727715-0003	295060	14	R6	D4	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00058	A170500-01	292293	1	B4	C4-1	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292294	2	B4	C4-3	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292295	3	B4	C4-4	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292296	4	B4	C4-6	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292297	5	B4	E4-1	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292298	6	B4	E4-3	B	1	1	6.8	0.3	22.666667	LA		ADX	1	1	1	NaK, WRTA	CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292299	7	B4	E4-4	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292300	8	B4	E4-6	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292301	9	B4	E5-1	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292302	10	B4	E5-3	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292303	11	B4	E5-4	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292304	12	B4	E5-6	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292305	13	B4	F3-1	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292306	14	B4	F3-3	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292307	15	B4	F3-4	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292308	16	B4	F3-6	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292309	17	B4	F4-1	CD33	2												CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292310	18	B4	F4-1	CF		2	9	0.9	10	LA		ADX	1		1	NaK, WRTA	CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292311	19	B4	F4-1	CF		0	7.2	0.2	36	LA		ADX	1			; Not PCME	CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292312	20	B4	F4-1	CF		0	26	0.7	37.142857	LA		ADX	1			; XNCGBLD	CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292313	21	B4	F4-3	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292314	22	B4	F4-4	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292315	23	B4	F4-6	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292316	24	B4	F5-1	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292317	25	B4	F5-3	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292318	26	B4	F5-4	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292319	27	B4	F5-6	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292320	28	B4	G2-3	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292321	29	B4	G2-6	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292322	30	B4	G3-3	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292323	31	B4	G3-6	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292324	32	B4	G4-1	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292325	33	B4	G4-3	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292326	34	B4	G4-4	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292327	35	B4	G4-6	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292328	36	B4	G5-1	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292329	37	B4	G5-3	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292330	38	B4	G5-4	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292331	39	B4	G5-6	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292332	40	B4	H4-1	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292333	41	B4	H4-3	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292334	42	B4	H4-4	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292335	43	B4	H4-6	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292336	44	B4	K4-1	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292337	45	B4	K4-3	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292338	46	B4	K4-4	F	3	3	9.8	0.3	32.666667	LA		ADX	1		1	NaK, WRTA	CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292339	47	B4	K4-6	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292340	48	A5	C3-1	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292341	49	A5	C3-3	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292342	50	A5	C3-4	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292343	51	A5	C3-6	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292344	52	A5	C4-1	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292345	53	A5	C4-3	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292346	54	A5	C4-4	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292347	55	A5	C4-6	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292348	56	A5	E3-1	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292349	57	A5	E3-3	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292350	58	A5	E3-4	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292351	59	A5	E3-6	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292352	60	A5	E4-1	F	4	4	5.2	0.3	17.333333	LA		ADX	1		1	NaK, WRTA	CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292353	61	A5	E4-3	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292354	62	A5	E4-4	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292355	63	A5	E4-6	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292356	64	A5	E5-1	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292357	65	A5	E5-3	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292358	66	A5	E5-4	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292359	67	A5	E5-6	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292360	68	A5	F3-1	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292361	69	A5	F3-3	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292362	70	A5	F3-4	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292363	71	A5	F3-6	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292364	72	A5	F4-1	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292365	73	A5	F4-3	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292366	74	A5	F4-4	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292367	75	A5	F4-6	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292368	76	A5	F5-1	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292369	77	A5	F5-3	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292370	78	A5	F5-4	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292371	79	A5	F5-6	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292372	80	A5	G3-1	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292373	81	A5	G3-3	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292374	82	A5	G3-4	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292375	83	A5	G3-6	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292376	84	A5	F6-1	ND													CDM Smith	T. Miller	1/31/2018			

ATTACHMENT 2
DATA SUMMARY OF STRUCTURE INFORMATION - AIR
Libby Asbestos Superfund Site - Operable Unit 3
2017 Cover Study

Sample Number	Lab Sample ID	Structure ID	Row Index	Grid	Grid Opening	Structure Type	Primary	Total	Length (µm)	Width (µm)	Aspect Ratio	Mineral Class	Mineral Description	Structure Identification	Sketch	Photo	EDS	Structure Comment	Verifier's Company	Verifier's Name	Date Verified	Verification Comment	Correction Date	DVC - 5%
CV-00058	A170500-01	292377	85	A5	F6-3	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292378	86	A5	F6-4	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292379	87	A5	F6-6	B	5	5	6.8	1.4	4.8571429	LA		ADX	1		1	NaK, WRTA	CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292380	88	A5	H3-1	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292381	89	A5	H3-3	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292382	90	A5	H3-4	ND													CDM Smith	T. Miller	1/31/2018			
CV-00058	A170500-01	292383	91	A5	H3-6	ND													CDM Smith	T. Miller	1/31/2018			
CV-00062	A170500-05	293211	1	A7	G2-3	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293212	2	A7	F2-6	B	1	1	17	2	8.5	LA		ADX	1		1	NaK, WRTA	CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293213	3	A7	F2-3	B	2	2	71	3	23.666667	LA		ADX	1		1	NaK, WRTA	CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293214	4	A7	E2-6	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293215	5	A7	E2-3	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293216	6	A7	C2-6	B	3	3	5.2	0.5	10.4	LA		ADX	1		1	NaK, WRTA	CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293217	7	A7	K3-3	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293218	8	A7	H3-6	B	4	4	5.1	0.7	7.2857143	LA		ADX	1		1	NaK, WRTA	CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293219	9	A7	H3-3	B	0	0	42	2	21	LA		ADX	1			; XNCGBLD	CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293220	10	A7	G3-6	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293221	11	A7	G3-3	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293222	12	A7	F3-6	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293223	13	A7	F3-3	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293224	14	A7	E3-6	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293225	15	A7	E3-3	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293226	16	A7	C3-6	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293227	17	A7	K4-3	B	5	5	10	1.3	7.6923077	LA		ADX	1		1	NaK, WRTA	CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293228	18	A7	H4-6	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293229	19	A7	H4-3	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293230	20	A7	G4-6	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293231	21	A7	G4-3	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293232	22	A7	F4-6	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293233	23	A7	F4-3	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293234	24	A7	E4-6	B	6	6	13	1	13	LA		ADX	1			NaK, WRTA	CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293235	25	A7	E4-3	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293236	26	A7	C4-6	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293237	27	A7	C4-3	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293238	28	A7	B4-6	B	0	0	19.5	0.5	39	LA		ADX	1			; XNCGBLD	CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293239	29	A7	H5-6	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293240	30	A7	H5-3	B	0	0	31	1.3	23.846154	LA		ADX	1			; XNCGBLD	CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293241	31	A7	G5-6	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293242	32	A7	G5-3	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293243	33	A7	F5-6	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293244	34	A7	F5-3	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293245	35	A7	E5-6	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293246	36	A7	E5-3	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293247	37	A7	C5-6	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293248	38	A7	H6-4	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293249	39	A7	H6-1	B	7	7	22	1	22	LA		ADX	1			NaK, WRTA; XGBLD	CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293250	40	A7	G6-4	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293251	41	A7	G6-1	MD11	8												CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293252	42	A7	G6-1	MB		8	7.5	0.6	12.5	LA		ADX	1			NaK, WRTA	CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293253	43	A7	F6-4	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293254	44	A7	F6-1	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293255	45	A7	E6-4	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293256	46	B7	H2-3	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293257	47	B7	G2-6	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293258	48	B7	G2-3	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293259	49	B7	F2-6	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293260	50	B7	F2-3	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293261	51	B7	E2-6	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293262	52	B7	E2-3	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293263	53	B7	C2-6	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293264	54	B7	K3-3	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293265	55	B7	H3-6	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293266	56	B7	H3-3	B	9	9	20	0.7	28.571429	LA		ADX	1			NaK, WRTA; XGBLD	CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293267	57	B7	G3-6	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293268	58	B7	G3-3	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293269	59	B7	F3-6	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293270	60	B7	F3-3	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293271	61	B7	E3-6	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293272	62	B7	E3-3	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293273	63	B7	C3-6	B	10	10	41	1	41	LA		ADX	1	1	1	NaK, WRTA	CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293274	64	B7	C3-3	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293275	65	B7	B3-6	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293276	66	B7	K4-3	B	11	11	25	0.7	35.714286	LA		ADX	1			NaK, WRTA; XGBLD	CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293277	67	B7	K4-3	B	12	12	6	1	6	LA		ADX	1			NaK, WRTA	CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293278	68	B7	H4-6	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293279	69	B7	H4-3	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293280	70	B7	G4-6	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293281	71	B7	G4-3	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293282	72	B7	F4-6	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293283	73	B7	F4-3	B	13	13	61	2	30.5	LA		ADX	1			NaK, WRTA	CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293284	74	B7	E4-6	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293285	75	B7	E4-3	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293286	76	B7	C4-6	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293287	77	B7	H5-6	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293288	78	B7	H5-3	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293289	79	B7	G5-6	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293290	80	B7	G5-3	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293291	81	B7	F5-6	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293292	82	B7	F5-3	B	14	14	18	1.2	15	LA		ADX	1			NaK, WRTA; XGBLD	CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293293	83	B7	E5-6	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293294	84	B7	E5-3	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293295	85	B7	C5-6	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293296	86	B7	C5-3	MD11	15												CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293297	87	B7	C5-3	MB		15	6.8	0.4	17	LA		ADX	1			NaK, WRTA	CDM Smith	T. Miller	2/1/2018			x-NR
CV-00062	A170500-05	293298	88	B7	B5-6	ND													CDM Smith	T. Miller	2/1/2018			x-NR
CV-00030	A170529-09	293746	1	B16	C5-4	ND													CDM Smith	T. Miller	2/1/2018			
CV-00030	A170529-09	293747	2	B16	E5-4	ND													CDM Smith	T. Miller	2/1/2018			
CV-00030	A170529-09	293748	3	B16	F4-4	ND													CDM Smith	T. Miller	2/1/2018			
CV-00030	A170529-09	293749	4	B16	F5-4	ND													CDM Smith	T. Miller	2/1/2018			
CV-00030	A170529-09	293750	5	B16	G3-4	ND													CDM Smith	T. Miller	2/1/2018			
CV-00030	A170529-09	293751	6	B16	G4-4	ND													CDM Smith	T. Miller	2/1/2018			
CV-00030	A170529-09	293752	7	B16	G5-4	ND													CDM Smith	T. Miller	2/1/2018			
CV-00030	A170529-09	293753	8	B16	H5-4	ND													CDM Smith	T. Miller	2/1/2018			
CV-00030	A170529-09	293754	9	A17	E4-1	ND													CDM Smith	T. Miller	2/1/2018			
CV-00030	A170529-09	293755	10	A17	E5-1	ND													CDM Smith	T. Miller	2/1/2018			
CV-00030	A170529-09	293756	11	A17	F3-1	ND													CDM Smith	T. Miller	2/1/2018			
CV-00030	A170529-09	293757	12	A17	F4-1	ND													CDM Smith	T. Miller	2/1/2018			
CV-00030	A170529-09	293758	13	A17	F5-1	ND													CDM Smith	T. Miller	2/1/2018			
CV-00030	A170529-09	293759	14	A17	G4-1	ND													CDM Smith	T. Miller	2/1/2018			
CV-00030	A170529-09	293760	15	A17	H4-1	ND													CDM Smith	T. Miller	2/1/2018			
CV-00030	A170529-09	293761	16	A17	K4-1	ND													CDM Smith	T. Miller	2/1/2018			
CV-00118	A170531-07	293862	1	B9	E3-1	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00118	A170531-07	293863	2	B9	E3-6	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00118	A170531-07	293864	3	B9	E4-1	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00118	A170531-07	293865	4	B9	E4-6	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00118	A170531-07	293866	5	B9	E5-1	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00118	A170531-07	293867	6	B9	F3-1	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00118	A170531-07	293868	7	B9	F3-6	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00118	A170531-07	293869	8	B9	F4-1	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00118	A170531-07	293870	9	B9	F4-6	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00118	A170531-07	293871	10	B9	F5-6	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00118	A170531-07	293872	11	B9	H3-1	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00118	A170531-07	293873	12	B9	H3-6	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00118	A170531-07	293874	13	B9	H4-6	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00118	A170531-07	293875	14	B9	H5-1	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00118	A170531-07	293876	15	B9	H6-1	ND													CDM Smith	T. Miller/DDE	2/1/2018			
CV-00118	A170531-07	293877	16	C9	C3-1	ND													CDM Smith	T. Miller	2/1/2018			
CV-00118	A170531-07	293878	17	C9	C3-6	ND													CDM Smith	T. Miller	2/1/2018			
CV-00118	A170531-07	293879	18	C9	C4-1	ND													CDM Smith	T. Miller	2/1/2018			
CV-00118	A170531-07	293880	19	C9	C4-6	ND													CDM Smith	T. Miller	2/1/2018			
CV-00118	A170531-07	293881	20	C9	C5-6	ND													CDM Smith	T. Miller	2/1/2018			
CV-00118	A170531-07	293882	21	C9	E3-1	ND													CDM Smith	T. Miller	2/1/2018			
CV-00118	A170531-07	293883	22	C9	E4-1	ND													CDM Smith	T. Miller	2/1/2018			
CV-00118	A170531-07	293884	23	C9	E4-6	ND													CDM Smith	T. Miller	2/1/2018			
CV-00118	A170531-07	293885	24	C9	E5-1	ND													CDM Smith	T. Miller	2/1/2018			
CV-00118	A170531-07	293886	25	C9	E5-6	ND													CDM Smith	T. Miller	2/1/2018			
CV-00118	A170531-07	293887	26	C9	G3-1	ND													CDM Smith	T. Miller	2/1/2018			
CV-00118	A170531-07	293888	27	C9	G3-6	ND													CDM Smith	T. Miller	2/1/2018			
CV-00118	A170531-07	293889	28	C9	G4-1	ND													CDM Smith	T. Miller	2/1/2018			
CV-00118	A170531-07	293890	29	C9	G4-6	ND													CDM Smith	T. Miller	2/1/2018			
CV-00118	A170531-07	293891	30	C9	G5-6	ND													CDM Smith	T. Miller	2/1/2018			
CV-00088	A170569-03	295222	1	C17	G2-6	ND													CDM Smith	T. Miller	2/1/2018			
CV-00088	A170569-03	295223	2	C17	F2-6	ND													CDM Smith	T. Miller	2/1/2018			
CV-00088	A170569-03	295224	3	C17	H3-3	ND													CDM Smith	T. Miller	2/1/2018			
CV-00088	A170569-03	295225	4	C17	F3-3	ND													CDM Smith	T. Miller	2/1/2018			
CV-00088	A170569-03	295226	5	C17	C3-6	ND													CDM Smith	T. Miller	2/1/2018			
CV-00088	A170569-03	295227	6	C17	C4-1	ND													CDM Smith	T. Miller	2/1/2018			
CV-00088	A170569-03	295228	7	C17	F4-1	ND													CDM Smith	T. Miller	2/1/2018			
CV-00088	A170569-03	295229	8	C17	K4-3	ND													CDM Smith	T. Miller	2/1/2018			
CV-00088	A170569-03	295230	9	C17	G4-3	ND													CDM Smith	T. Miller	2/1/2018			
CV-00088	A170569-03	295231	10	C17	K5-4	ND													CDM Smith	T. Miller	2/1/2018			
CV-00088	A170569-03	295232	11	C17	H5-4	ND													CDM Smith	T. Miller	2/1/2018			
CV-00088	A170569-03	295233	12	C17	F5-4	ND													CDM Smith	T. Miller	2/1/2018			
CV-00088	A170569-03	295234	13	C17	E5-1	ND													CDM Smith	T. Miller	2/1/2018			
CV-00088	A170569-03	295235	14	C17	F5-6	ND													CDM Smith	T. Miller	2/1/2018			
CV-00088	A170569-03	295236	15	C17	G6-4	ND													CDM Smith	T. Miller	2/1/2018			
CV-00088	A170569-03	295237	16	A18	F2-1	ND													CDM Smith	T. Miller	2/1/2018			
CV-00088	A170569-03	295238	17	A18	F2-6	ND													CDM Smith	T. Miller	2/1/2018			
CV-00088	A170569-03	295239	18	A18	E2-3	ND													CDM Smith	T. Miller	2/1/2018			
CV-00088	A170569-03	295240	19	A18	C3-4	ND													CDM Smith	T. Miller	2/1/2018			
CV-00088	A170569-03	295241	20	A18	H3-4	ND													CDM Smith	T. Miller	2/1/2018			
CV-00088	A170569-03	295242	21	A18	K3-6	ND													CDM Smith	T. Miller	2/1/2018			
CV-00088	A170569-03	295243	22	A18	G3-6	ND													CDM Smith	T. Miller	2/1/2018			
CV-00088	A170569-03	295244	23	A18	K4-1	ND													CDM Smith	T. Miller	2/1/2018			
CV-00088	A170569-03	295245	24	A18	H4-1	ND													CDM Smith	T. Miller	2/1/2018			
CV-00088	A170569-03	295246	25	A18	F4-4	ND													CDM Smith	T. Miller	2/1/2018			
CV-00088	A170569-03	295247	26	A18	B4-1	ND													CDM Smith	T. Miller	2/1/2018			
CV-00088	A170569-03	295248	27	A18	C4-3	ND													CDM Smith	T. Miller	2/1/2018			
CV-00088	A170569-03	295249	28	A18	F5-4	ND													CDM Smith	T. Miller	2/1/2018			
CV-00088	A170569-03	295250	29	A18	C5-4	ND													CDM Smith	T. Miller	2/1/2018			

Notes:
µm = micrometer
ABS = activity-based sampling
DDE = direct data entry
DVC = Data Verification Coordinator
EDS = energy dispersive spectroscopy
ID = identification
LA = Libby amphibole asbestos
NAM = non-asbestos material
OA = other amphibole

Attachment 3

Laboratory Documentation

TLF-12.01
Effective Date: 07/03/2014

TEM Asbestos Structure Count Bench Sheet

Laboratory Name	ESATR8
Site or Project Name	Libby 08BC [OU3]
Client	USEPA Region 8
Chain of Custody Number	230617JK01
Lab Job Number	A170233
Lab Sample ID	A170233-02
Client Sample Number	AC-00002
Tag	AL1
Lab Receipt Date	06/27/2017
Analysis Method	TEM-ISO
Sample Matrix	Air
Sample Type (field, blank, etc.)	Field Sample
QC Type	Not QC
Analysis Status	Analyzed
Prepared By	N. DelHierro
Preparation Date	06/28/2017
Volume (L) or Area (cm²)	542
Lab Comments	
Grid Prep Acceptable? Y or N (explain)	

Circle Prep Type:	Direct Indirect Indirect-Ashed
Loose Material in cowl?	Y N
Est. Filter Particulate Loading (%)	2
Instrument	JEOL JEM-1011 (C24)
Voltage (kV)	100
Magnification (X)	5,000
Primary Filter Area (mm²)	385
Primary Filter Pore Size (µm)	0.8
Sec Filter Area (mm²)	-
Sec Filter Pore Size (µm)	-
Grid Opening Area (mm²)	0.0103
Number of Grids Prepared	3
Archive Filter(s) Location	ESATR8
Grid Storage Location	ESATR8
Grid Box	A151
Grid Slots	A1, B1, C1
Filter Type	MCE

Minimum Aspect Ratio	3:1
Minimum Length (µm)	>5
Minimum Width (µm)	0.25
Max # Structures	25
Max # Grid Openings	49
Target Analytical Sensitivity (s/cc)	0.033
# of GO's to Reach Target AS	3
GO Traverse Direction (V or H)	H
GO Orientation (Sketch letter F)	F, F

F-Factor Calculation (if applicable)

Indirect Fraction Primary Filter	-
Analysis Aliquot 1 (mL)	-
Analysis Volume 1 (ml)	-
Indirect Fraction Secondary Filter	-
Analysis Aliquot 2 (mL)	-
Analysis Volume 2 (mL)	-
Analysis Aliquot 3 (mL)	-
Analysis Volume 3 (mL)	-
F-Factor	1

GO #	Grid	Grid Opening	Structure Type (ND, F, B, CD, CB, CF, MD, etc.)	Number of Structures		Structure Dimensions (µm)		ID Method (ADX, CD, NAM, etc.)	Mineral Class (check one)				Sketch/ Comments	Mineral ID (WRTA, AC, TR, AT, AM, AN, CH, CR, PY, OT, UN)	EDXA Observation (NaK, NaX, XK, XX, NA)	Record number of spectrum or photo if taken		Check if GO not analyzed for Chrysotile
				Primary	Total	Length	Width		LA	OA	CH	NAM				Photo	EDXA (spectrum saved)	
1	A1	E3-3	ND															
	↓	G2-3																
	B1	F3-3																
4	↓	H4-1	↓															

0/4

Analyst: N. DelHierro

Date: 6/28/17

0/4

TDM

TEM Asbestos Structure Count Bench Sheet

Laboratory Name	ESATR8
Site or Project Name	Libby 08BC [OU3]
Client	USEPA Region 8
Chain of Custody Number	230617JK01
Lab Job Number	A170233
Lab Sample ID	A170233-04
Client Sample Number	AC-00004
Tag	AL1
Lab Receipt Date	06/27/2017
Analysis Method	TEM-ISO
Sample Matrix	Air
Sample Type (field, blank, etc.)	Field Sample
QC Type	Not QC
Analysis Status	Analyzed
Prepared By	N. DelHierro
Preparation Date	06/28/2017
Volume (L) or Area (cm²)	551
Lab Comments	
Grid Prep Acceptable? Y or N (explain)	Y

Circle Prep Type: Direct Indirect Indirect-Ashed	Indirect
Loose Material in cowl?	Y N — N
Est. Filter Particulate Loading (%)	5
Instrument	JEOL JEM-1011 (C24)
Voltage (kV)	100
Magnification (X)	5,000
Primary Filter Area (mm²)	385
Primary Filter Pore Size (µm)	0.8
Sec Filter Area (mm²)	-
Sec Filter Pore Size (µm)	-
Grid Opening Area (mm²)	0.0103
Number of Grids Prepared	3
Archive Filter(s) Location	ESATR8
Grid Storage Location	ESATR8
Grid Box	4151
Grid Slots	A2, B2, A3
Filter Type	MCE

Minimum Aspect Ratio	3:1
Minimum Length (µm)	>5
Minimum Width (µm)	0.25
Max # Structures	25
Max # Grid Openings	49
Target Analytical Sensitivity (s/cc)	0.033
# of GO's to Reach Target AS	3
GO Traverse Direction (V or H)	H
GO Orientation (Sketch letter F)	F, F

F-Factor Calculation (if applicable)

Indirect Fraction Primary Filter	-
Analysis Aliquot 1 (mL)	-
Analysis Volume 1 (ml)	-
Indirect Fraction Secondary Filter	-
Analysis Aliquot 2 (mL)	-
Analysis Volume 2 (mL)	-
Analysis Aliquot 3 (mL)	-
Analysis Volume 3 (mL)	-
F-Factor	1

GO #	Grid	Grid Opening	Structure Type (ND, F, B, CD, CB, CF, MD, etc.)	Number of Structures: Primary	Number of Structures: Total	Structure Dimensions (µm): Length	Structure Dimensions (µm): Width	ID Method (ADX, CD, NAM, etc.)	Mineral Class (check one): LA	OA	CH	NAM	Sketch/ Comments	Mineral ID (WRTA, AC, TR, AT, AM, AN, CH, CR, PY, OT, UN)	EDXA Observation (NaK, NaX, XK, XX, NA)	Record number of spectrum or photo if taken: Photo	EDXA (spectrum saved)	Check if GO not analyzed for Chrysotile
1	A2	H4-4	ND															
	↓	G3-6	↓															
	B2	C4-1	↓															
4	↓	F5-6	↓															

0/4

Analyst: N. DelHierro

Date: 6/28/17

0/4

Corrected ✓ nn

TEM Asbestos Structure Count Bench Sheet

Laboratory Name	ESATR8
Site or Project Name	Libby 08BC [OU3]
Client	USEPA Region 8
Chain of Custody Number	230617JK01
Lab Job Number	A170233
Lab Sample ID	A170233-04
Client Sample Number	AC-00004
Tag	AL1
Lab Receipt Date	06/27/2017
Analysis Method	TEM-ISO
Sample Matrix	Air
Sample Type (field, blank, etc.)	Field Sample
QC Type	Not QC
Analysis Status	Analyzed
Prepared By	N. DelHierro
Preparation Date	06/28/2017
Volume (L) or Area (cm²)	551
Lab Comments	
Grid Prep Acceptable? Y or N (explain)	

Circle Prep Type: Direct ~~Indirect~~ Indirect-Ashed (ND 9/21/17)	
Loose Material in cowl?	Y N
Est. Filter Particulate Loading (%)	5
Instrument	JEOL JEM-1011 (C24)
Voltage (kV)	100
Magnification (X)	5,000
Primary Filter Area (mm²)	385
Primary Filter Pore Size (µm)	0.8
Sec Filter Area (mm²)	-
Sec Filter Pore Size (µm)	-
Grid Opening Area (mm²)	0.0103
Number of Grids Prepared	3
Archive Filter(s) Location	ESATR8
Grid Storage Location	ESATR8
Grid Box	A151
Grid Slots	A2, B2, A3
Filter Type	MCE

Minimum Aspect Ratio	3:1
Minimum Length (µm)	>5
Minimum Width (µm)	0.25
Max # Structures	25
Max # Grid Openings	49
Target Analytical Sensitivity (s/cc)	0.033
# of GO's to Reach Target AS	3
GO Traverse Direction (V or H)	H
GO Orientation (Sketch letter F)	F, F

F-Factor Calculation (if applicable)

Indirect Fraction Primary Filter	-
Analysis Aliquot 1 (mL)	-
Analysis Volume 1 (ml)	-
Indirect Fraction Secondary Filter	-
Analysis Aliquot 2 (mL)	-
Analysis Volume 2 (mL)	-
Analysis Aliquot 3 (mL)	-
Analysis Volume 3 (mL)	-
F-Factor	1

GO #	Grid	Grid Opening	Structure Type (ND, F, B, CD, CB, CF, MD, etc.)	Number of Structures		Structure Dimensions (µm)		ID Method (ADX, CD, NAM, etc.)	Mineral Class (check one)				Sketch/ Comments	Mineral ID (WRTA, AC, TR, AT, AM, AN, CH, CR, PY, OT, UN)	EDXA Observation (NaK, NaX, XK, XX, NA)	Record number of spectrum or photo if taken		Check if GO not analyzed for Chrysotile
				Primary	Total	Length	Width		LA	OA	CH	NAM				Photo	EDXA (spectrum saved)	
1	A2	H4-4	ND															
	↓	G3-6	↓															
	B2	C4-1	↓															
4	↓	F5-6	↓															

Analyst: N. DelHierro

Date: 6/28/17

TEM Asbestos Structure Count Bench Sheet

Laboratory Name	ESATR8
Site or Project Name	Libby 08BC [OU3]
Client	USEPA Region 8
Chain of Custody Number	230617JK01
Lab Job Number	A170233
Lab Sample ID	A170233-06
Client Sample Number	AC-00006
Tag	AL1
Lab Receipt Date	06/27/2017
Analysis Method	TEM-ISO
Sample Matrix	Air
Sample Type (field, blank, etc.)	Field sample
QC Type	Not QC
Analysis Status	Analyzed
Prepared By	N. DelHierro
Preparation Date	06/28/2017
Volume (L) or Area (cm²)	531
Lab Comments	
Grid Prep Acceptable? Y or N (explain)	

Circle Prep Type: Direct Indirect Indirect-Ashed	Direct
Loose Material in cowl?	Y N — N
Est. Filter Particulate Loading (%)	4
Instrument	JEOL JEM-1011 (C24)
Voltage (kV)	100
Magnification (X)	5,000
Primary Filter Area (mm²)	385
Primary Filter Pore Size (µm)	0.8
Sec Filter Area (mm²)	-
Sec Filter Pore Size (µm)	-
Grid Opening Area (mm²)	0.0103
Number of Grids Prepared	3
Archive Filter(s) Location	ESATR8
Grid Storage Location	ESATR8
Grid Box	A151
Grid Slots	B3, C3, A4
Filter Type	MCE

Minimum Aspect Ratio	3:1
Minimum Length (µm)	>5
Minimum Width (µm)	0.25
Max # Structures	25
Max # Grid Openings	49
Target Analytical Sensitivity (s/cc)	0.033
# of GO's to Reach Target AS	3
GO Traverse Direction (V or H)	H
GO Orientation (Sketch letter F)	F, F

F-Factor Calculation (if applicable)

Indirect Fraction Primary Filter	-
Analysis Aliquot 1 (mL)	-
Analysis Volume 1 (ml)	-
Indirect Fraction Secondary Filter	-
Analysis Aliquot 2 (mL)	-
Analysis Volume 2 (mL)	-
Analysis Aliquot 3 (mL)	-
Analysis Volume 3 (mL)	-
F-Factor	1

0/4
50% DVC

GO #	Grid	Grid Opening	Structure Type (ND, F, B, CD, CB, CF, MD, etc.)	Number of Structures: Primary	Number of Structures: Total	Structure Dimensions (µm): Length	Structure Dimensions (µm): Width	ID Method (ADX, CD, NAM, etc.)	Mineral Class (check one): LA	OA	CH	NAM	Sketch/ Comments	Mineral ID (WRTA, AC, TR, AT, AM, AN, CH, CR, PY, OT, UN)	EDXA Observation (NaK, NaX, XK, XX, NA)	Record number of spectrum or photo if taken: Photo	EDXA (spectrum saved)	Check if GO not analyzed for Chrysotile
1	B3	C5-1	ND															
	↓	G3-3																
	C3	G4-4																
4	↓	E2-6	↓															

Analyst: N. DelHierro

0/4

Date: 6/28/17

0/4

TDM

TEM Asbestos Structure Count Bench Sheet

Laboratory Name	ESATR8
Site or Project Name	Libby 08BC [OU3]
Client	USEPA Region 8
Chain of Custody Number	230617JK01
Lab Job Number	A170233
Lab Sample ID	A170233-08
Client Sample Number	AC-00008
Tag	AL1
Lab Receipt Date	06/27/2017
Analysis Method	TEM-ISO
Sample Matrix	Air
Sample Type (field, blank, etc.)	Field sample
QC Type	Not QC
Analysis Status	Analyzed
Prepared By	N. DelHierro
Preparation Date	06/28/2017
Volume (L) or Area (cm²)	540
Lab Comments	
Grid Prep Acceptable? Y or N (explain)	

Circle Prep Type: Direct Indirect Indirect-Ashed	Direct
Loose Material in cowl?	Y N — N
Est. Filter Particulate Loading (%)	9
Instrument	JEOL JEM-1011 (C24)
Voltage (kV)	100
Magnification (X)	5,000
Primary Filter Area (mm²)	385
Primary Filter Pore Size (µm)	0.8
Sec Filter Area (mm²)	-
Sec Filter Pore Size (µm)	-
Grid Opening Area (mm²)	0.0103
Number of Grids Prepared	3
Archive Filter(s) Location	ESATR8
Grid Storage Location	ESATR8
Grid Box	4151
Grid Slots	B4, A5, B5
Filter Type	MCE

Minimum Aspect Ratio	3:1
Minimum Length (µm)	>5
Minimum Width (µm)	0.25
Max # Structures	25
Max # Grid Openings	49
Target Analytical Sensitivity (s/cc)	0.033
# of GO's to Reach Target AS	3
GO Traverse Direction (V or H)	H
GO Orientation (Sketch letter F)	F, F

F-Factor Calculation (if applicable)

Indirect Fraction Primary Filter	-
Analysis Aliquot 1 (mL)	-
Analysis Volume 1 (ml)	-
Indirect Fraction Secondary Filter	-
Analysis Aliquot 2 (mL)	-
Analysis Volume 2 (mL)	-
Analysis Aliquot 3 (mL)	-
Analysis Volume 3 (mL)	-
F-Factor	1

GO #	Grid	Grid Opening	Structure Type (ND, F, B, CD, CB, CF, MD, etc.)	Number of Structures: Primary	Number of Structures: Total	Structure Dimensions (µm): Length	Structure Dimensions (µm): Width	ID Method (ADX, CD, NAM, etc.)	Mineral Class (check one): LA	OA	CH	NAM	Sketch/ Comments	Mineral ID (WRTA, AC, TR, AT, AM, AN, CH, CR, PY, OT, UN)	EDXA Observation (NaK, NaX, XK, XX, NA)	Record number of spectrum or photo if taken: Photo	EDXA (spectrum saved)	Check if GO not analyzed for Chrysotile
1	B4	B5-4	ND															
	↓	F5-3	↓															
	A5	K5-3																
4	↓	G4-1	↓															

0/4

Analyst: N. DelHierro

Date: 6/28/17

0/4

VDM

Structure Sketch Sheet for Direct Data Entry

EMSL Sample ID: 041718445-0002 ✓ **Client:** Techlaw

Client Sample: AC-00011 ✓ Page 1 of 1

Primary Structure #	Primary Structure #	Primary Structure #	Primary Structure #
NSD ✓			

Primary Structure #	Primary Structure #	PrimaryStructure #	Primary Structure #

PrimaryStructure #	Primary Structure #	Primary Structure #	Primary Structure #

Primary Structure #	Primary Structure #	Primary Structure #	Primary Structure #

Primary Structure #	Primary Structure #	Primary Structure #	Primary Structure #

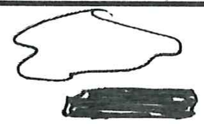
Analyst: [signature] ✓ Date: 6/28/17 ✓ Scope: 04-06 ✓

✓ TDR

Structure Sketch Sheet for Direct Data Entry

EMSL Sample ID: 041718445-0004 **Client:** Techlaw

Client Sample: AC-00013 Page 1 of 1

Primary Structure # 1 	Primary Structure #	Primary Structure #	Primary Structure #
Primary Structure #	Primary Structure #	PrimaryStructure #	Primary Structure #
PrimaryStructure #	Primary Structure #	Primary Structure #	Primary Structure #
Primary Structure #	Primary Structure #	Primary Structure #	Primary Structure #
Primary Structure #	Primary Structure #	Primary Structure #	Primary Structure #

Analyst: Date: 6/28/17 Scope: 04-06

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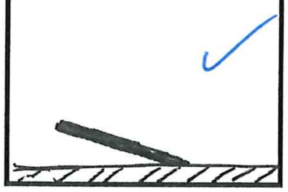
1 structure

TDM

Structure Sketch Sheet for Direct Data Entry

EMSL Sample ID: 041718445-0006 ✓ **Client:** Techlaw

Client Sample: AC-00015 ✓ Page 1 of 1

Primary Structure # 1 	Primary Structure #	Primary Structure #	Primary Structure #
Primary Structure #	Primary Structure #	PrimaryStructure #	Primary Structure #
PrimaryStructure #	Primary Structure #	Primary Structure #	Primary Structure #
Primary Structure #	Primary Structure #	Primary Structure #	Primary Structure #
Primary Structure #	Primary Structure #	Primary Structure #	Primary Structure #

Analyst: [signature] ✓ Date: 6/28/17 ✓ Scope: 04-08 ✓

1 structure ✓

TDM

Structure Sketch Sheet for Direct Data Entry

EMSL Sample ID: 041718445-0008

Client Sample: AC-00017

Client: Techlaw

Page 1 of 1

Primary Structure # NSD	Primary Structure #	Primary Structure #	Primary Structure #
Primary Structure #	Primary Structure #	PrimaryStructure #	Primary Structure #
PrimaryStructure #	Primary Structure #	Primary Structure #	Primary Structure #
Primary Structure #	Primary Structure #	Primary Structure #	Primary Structure #
Primary Structure #	Primary Structure #	Primary Structure #	Primary Structure #

Analyst: [illegible] Date: 6/28/17 Scope: 01-06

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VTDM

EFA 1338mm² Filter lot # 60610200

LIBBY DUFF PREPARATION SAMPLE DATA SHEET (PSDS)

Laboratory Name: EMSL-04

Lab Job No.: 041718876

Lab QC Batch No.: ok

SOP: EPA-LIBBY-2012-11 (Rev 3)

Preparation by: JG

Preparation Date: 7/3/17

Drying Oven Temp. (°C): —

Muffle Furnace Temp. (°C): —

HCL Reagent Tracking No: HCl 17-177

	SAMPLE INFORMATION			DRYING						ASHING				FILTER PREP				
	Index ID	Lab Sample ID	Mass (g), as received	Tray ID(s) used in drying	Tray weight (g)	Mass (g), during drying [tray + sample] Check 1	Check 2	Check 3	Mass (g), after drying [sample only]	Pan ID(s) used in ashing	Pan weight (g)	Mass (g), after ashing [pan + sample]	Mass (g), after ashing [sample only]	Rep. ID	Mass of ash (g) taken for analysis	Volume of HCl added (mL)	Total volume (mL)	Aliquot volume (mL)	Notes
Example	X-12345	026589	500.31	A	5.71	63.12	55.90	55.84	50.13	A	15.87	36.98	21.11	—	0.26	15	100	1.0	
Example	↓	↓	↓	B	4.99	70.56	63.02	63.11	58.12	B	16.20	44.05	27.85						
Example				C	5.23	89.63	71.85	72.03	66.80										
Example	X-12346	026590	486.22	A	5.89	64.05	56.44	56.23	50.34	A	16.32	87.21	70.89	Rep1	0.26	15	100	0.1	
Example	↓	↓	↓	B	4.65	71.55	63.57	63.54	58.89					Rep2	0.25	13	100	0.5	
Example				C	5.12	90.51	72.47	72.00	66.88					Rep3	0.24	14	100	0.1	
	AC-00019	18876-0001	56.67											Rep1	0.25	10	100	5, 3	2, 1, 0.5
	AC-00019	18876-0001A	↓											Rep2	0.25	10	100	5, 3	2, 1, 0.5
	AC-00019	18876-0001B	↓											Rep3	0.25	10	100	5, 3	2, 1, 0.5
	Filtration Blank																100	100	

Note: All mass measurements should be recorded to an accuracy of ± 0.01 g.

QA Check by: ok   Date:

Small rocks present in sample. Avoided rocks when taking sub sample. ok

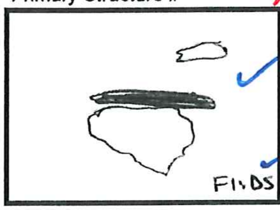
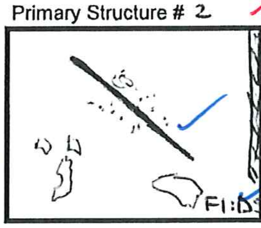
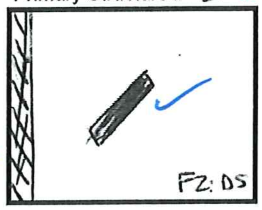
NW 5% DVC

TDM

Structure Sketch Sheet for Direct Data Entry

EMSL Sample ID: 041718876-0001 **Client:** Techlaw

Client Sample: AC-00019 Rep1 **Page** ______ **of** ______

Primary Structure # 1	Primary Structure # 2	Primary Structure # 3	Primary Structure #
			

0417-Techlaw03
F1-4

Primary Structure #	Primary Structure #	PrimaryStructure #	Primary Structure #

PrimaryStructure #	Primary Structure #	Primary Structure #	Primary Structure #

Primary Structure #	Primary Structure #	Primary Structure #	Primary Structure #

Primary Structure #	Primary Structure #	Primary Structure #	Primary Structure #

Analyst: W. Nguyen Date: 7/12/17 Scope: 04DS

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3 structures

NN 5/10 DVC

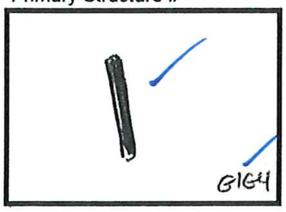
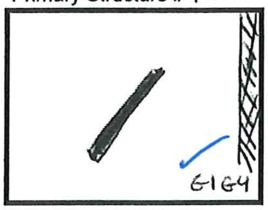
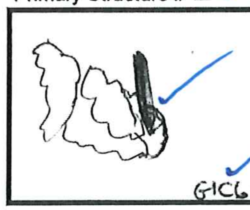
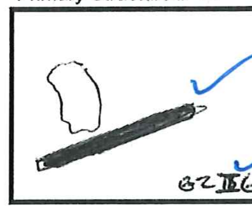
Structure Sketch Sheet for Direct Data Entry

EMSL Sample ID: 041718876-0001A

Client Sample: AC-00019 Rep2

Client: Techlaw

Page 1 of 1

Primary Structure # 0	Primary Structure # 1	Primary Structure # 2	Primary Structure # 3
 	 	 	
Primary Structure #	Primary Structure #	PrimaryStructure #	Primary Structure #
PrimaryStructure #	Primary Structure #	Primary Structure #	Primary Structure #
Primary Structure #	Primary Structure #	Primary Structure #	Primary Structure #
Primary Structure #	Primary Structure #	Primary Structure #	Primary Structure #

0417-Techlaw03
G1-4

Analyst: Will Nguyen

Date: 7/13/17

Scope: 0405

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3 structures

TDM

Structure Sketch Sheet for Direct Data Entry

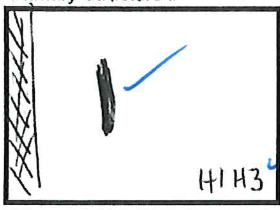
EMSL Sample ID: 041718876-0001B

Client: Techlaw

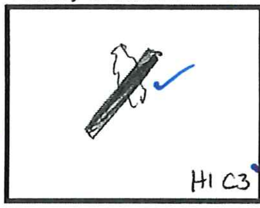
Client Sample: AC-00019 Rep3

Page 1 **of** 1

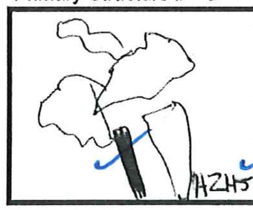
Primary Structure # 1



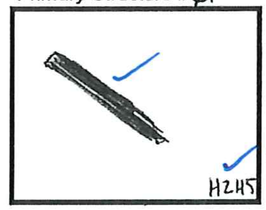
Primary Structure # 2



Primary Structure # 3



Primary Structure # Ø



0417-Techlaw 03
H 1-

Primary Structure #

Primary Structure #

PrimaryStructure #

Primary Structure #

PrimaryStructure #

Primary Structure #

Primary Structure #

Primary Structure #

Primary Structure #

Primary Structure #

Primary Structure #

Primary Structure #

Primary Structure #

Primary Structure #

Primary Structure #

Primary Structure #

Analyst: Will Nguyen

Date: 7/14/17

Scope: 0405

3 structures

TDM

EMSL

Structure Sketch Sheet for Direct Data Entry

EMSL Sample ID: 321725158-0010 ✓ **Client:** Techlaw

Client Sample: CV-00010 Page 1 of 1

Primary Structure # 1	Primary Structure # 2	Primary Structure # 3	Primary Structure # 4
Primary Structure # 5	Primary Structure # 0 XNCGBLD	Primary Structure # 6	Primary Structure # 7
Primary Structure # 8	Primary Structure # 0	Primary Structure # 0 XNCGBLD	Primary Structure # 9
Primary Structure # 10 XGBLD	Primary Structure # 11 (OA)	Primary Structure # 12	Primary Structure # 13
Primary Structure # 0 ⊛ XNCGBLD	Primary Structure #	Primary Structure #	Primary Structure #

Analyst: K. Corbin ✓ Date: 11/6/17 ✓ Scope: 32-04 ✓

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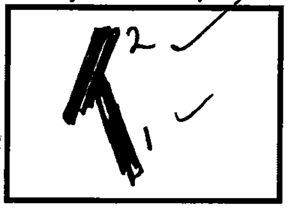
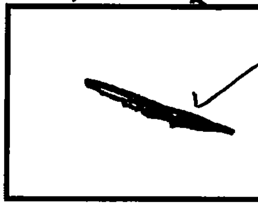
⊛ Length not doubled; the length of fiber greater than the width of grid bar.

✓ TDM

Structure Sketch Sheet for Direct Data Entry

EMSL Sample ID: 041730938-0001 ✓ **Client:** Techlaw

Client Sample: CV-00012 ✓ Page 1 of 1

Primary Structure # 1	Primary Structure # 2	Primary Structure #	Primary Structure #
			
Primary Structure #	Primary Structure #	PrimaryStructure #	Primary Structure #
PrimaryStructure #	Primary Structure #	Primary Structure #	Primary Structure #
Primary Structure #	Primary Structure #	Primary Structure #	Primary Structure #
Primary Structure #	Primary Structure #	Primary Structure #	Primary Structure #

Analyst: [signature] ✓ Date: 11/10/17 ✓ Scope: 04-08 ✓

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EMSL

Structure Sketch Sheet for Direct Data Entry

EMSL Sample ID: 041730938-0007 **Client:** Techlaw

Client Sample: CV-00018 Page 1 of 1

Primary Structure # NSD	Primary Structure #	Primary Structure #	Primary Structure #
Primary Structure #	Primary Structure #	PrimaryStructure #	Primary Structure #
PrimaryStructure #	Primary Structure #	Primary Structure #	Primary Structure #
Primary Structure #	Primary Structure #	Primary Structure #	Primary Structure #
Primary Structure #	Primary Structure #	Primary Structure #	Primary Structure #

Analyst: Date: 11/13/17 Scope: 04-06

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EMSL

Structure Sketch Sheet for Direct Data Entry

EMSL Sample ID: 041728469-0001 **Client:** Techlaw

Client Sample: CV-00068 Page 1 of 1

Primary Structure # 1  I1 F6	Primary Structure # 2  I2 D4	Primary Structure #	Primary Structure #
Primary Structure #	Primary Structure #	PrimaryStructure #	Primary Structure #
PrimaryStructure #	Primary Structure #	Primary Structure #	Primary Structure #
Primary Structure #	Primary Structure #	Primary Structure #	Primary Structure #
Primary Structure #	Primary Structure #	Primary Structure #	Primary Structure #

Analyst: Will Nguyen Date: 10/2/17 Scope: 04-05

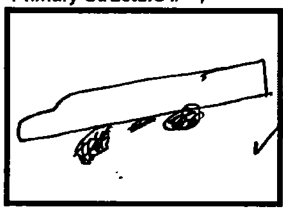
TDM

Structure Sketch Sheet for Direct Data Entry

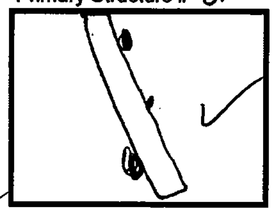
EMSL Sample ID: 041728469-0005 **Client:** Techlaw

Client Sample: CV-00072 Page 1 of 1

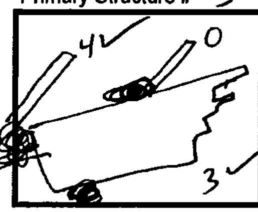
Primary Structure # 1



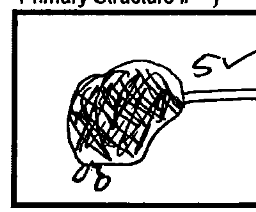
Primary Structure # 2



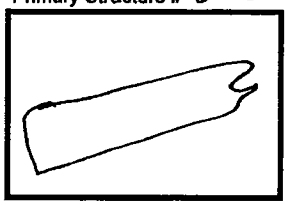
Primary Structure # 3



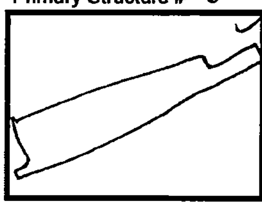
Primary Structure # 4



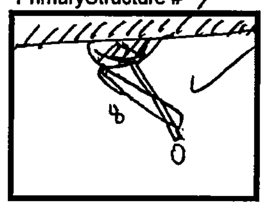
Primary Structure # 5



Primary Structure # 6



PrimaryStructure # 7



Primary Structure #

PrimaryStructure #

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Primary Structure #

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Primary Structure #

Primary Structure #

Primary Structure #

Analyst: FC Date: 10/6/17 Scope: 04-01

TDM

Structure Sketch Sheet for Direct Data Entry

EMSL Sample ID: 041734167-0005 **Client:** Techlaw

Client Sample: CV-00100 Page 1 of 1

Primary Structure # ND	Primary Structure #	Primary Structure #	Primary Structure #
Primary Structure #	Primary Structure #	PrimaryStructure #	Primary Structure #
PrimaryStructure #	Primary Structure #	Primary Structure #	Primary Structure #
Primary Structure #	Primary Structure #	Primary Structure #	Primary Structure #
Primary Structure #	Primary Structure #	Primary Structure #	Primary Structure #

Analyst: FC Date: 12/1/17 Scope: 04-01

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TD

Structure Sketch Sheet for Direct Data Entry

EMSL Sample ID: 321727715-0003

Client: Techlaw

Client Sample: CV-00106

Page 1 of 1

Primary Structure # ND	Primary Structure #	Primary Structure #	Primary Structure #
Primary Structure #	Primary Structure #	PrimaryStructure #	Primary Structure #
PrimaryStructure #	Primary Structure #	Primary Structure #	Primary Structure #
Primary Structure #	Primary Structure #	Primary Structure #	Primary Structure #
Primary Structure #	Primary Structure #	Primary Structure #	Primary Structure #

Analyst: K. Colbin Date: 11/20/17 Scope: 32-044

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TDM

Structure Sketch Sheet for Direct Data Entry

EMSL Sample ID: 041730929-0007

Client Sample: CV-00138

Client: Techlaw

Page 1 of 1

Primary Structure #	Primary Structure #	Primary Structure #	Primary Structure #
ND			

Primary Structure #	Primary Structure #	PrimaryStructure #	Primary Structure #

PrimaryStructure #	Primary Structure #	Primary Structure #	Primary Structure #

Primary Structure #	Primary Structure #	Primary Structure #	Primary Structure #

Primary Structure #	Primary Structure #	Primary Structure #	Primary Structure #

Analyst: WN Date: 10/26/17 Scope: 04-03

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TDM

TEM Asbestos Structure Count Bench Sheet

Laboratory Name	ESATR8
Site or Project Name	Libby 08BC [OU3]
Client	USEPA Region 8
Chain of Custody Number	230917JP01
Lab Job Number	A170529
Lab Sample ID	A170529-09
Client Sample Number	CV-00030
Tag	AL1
Lab Receipt Date	10/23/2017
Analysis Method	TEM-ISO
Sample Matrix	Air
Sample Type (field, blank, etc.)	Field Sample
QC Type	Not QC
Analysis Status	Analyzed
Prepared By	N. DelHierro
Preparation Date	10/24/2017
Volume (L) or Area (cm²)	40
Lab Comments	
Grid Prep Acceptable? Y or N (explain)	Y

Circle Prep Type: Direct Indirect Indirect-Ashed	Direct
Loose Material in cowl?	Y N — N
Est. Filter Particulate Loading (%)	3
Instrument	JEOL JEM-1011 (C24)
Voltage (kV)	100
Magnification (X)	5,000
Primary Filter Area (mm²)	385
Primary Filter Pore Size (µm)	0.8
Sec Filter Area (mm²)	-
Sec Filter Pore Size (µm)	-
Grid Opening Area (mm²)	0.0103
Number of Grids Prepared	3
Archive Filter(s) Location	ESATR8
Grid Storage Location	ESATR8
Grid Box	A160
Grid Slots	B16, A17, B17
Filter Type	MCE

Minimum Aspect Ratio	3:1
Minimum Length (µm)	> 5
Minimum Width (µm)	0.25
Max # Structures	25
Max # Grid Openings	39
Target Analytical Sensitivity (s/cc)	0.060
# of GO's to Reach Target AS	16
GO Traverse Direction (V or H)	H
GO Orientation (Sketch letter F)	F, F

F-Factor Calculation (if applicable)

Indirect Fraction Primary Filter	-
Analysis Aliquot 1 (mL)	-
Analysis Volume 1 (ml)	-
Indirect Fraction Secondary Filter	-
Analysis Aliquot 2 (mL)	-
Analysis Volume 2 (mL)	-
Analysis Aliquot 3 (mL)	-
Analysis Volume 3 (mL)	-
F-Factor	1

GO #	Grid	Grid Opening	Structure Type (ND, F, B, CD, CB, CF, MD, etc.)	Number of Structures: Primary	Number of Structures: Total	Structure Dimensions (µm): Length	Structure Dimensions (µm): Width	ID Method (ADX, CD, NAM, etc.)	Mineral Class (check one): LA	OA	CH	NAM	Sketch/ Comments	Mineral ID (WRTA, AC, TR, AT, AM, AN, CH, CR, PY, OT, UN)	EDXA Observation (NaK, NaX, XK, XX, NA)	Record number of spectrum or photo if taken: Photo	EDXA (spectrum saved)	Check if GO not analyzed for Chrysotile
	B16	C5-4	ND															
	↓	E5-4	↓															
	↓	F4-4	↓															
	↓	F5-4	↓															
	↓	G3-4	↓															

0/5

Analyst: D. Kent

0/16

Date: 10/27/17

TDM

TEM Asbestos Structure Count Bench Sheet

QC Type: Not QC

Lab Job Number: A170529

Client Sample Number: CV-00030

Lab Sample ID: A170529-09

GO #	Grid	Grid Opening	Structure Type (ND, F, B, CD, CB, CF, MD, etc.)	Number of Structures		Structure Dimensions (µm)		ID Method (ADX, CD, NAM, etc.)	Mineral Class (check one)				Sketch/ Comments	Mineral ID (WRTA, AC, TR, AT, AM, AN, CH, CR, PY, OT, UN)	EDXA Observation (NaK, NaX, XK, XX, NA)	Record number of spectrum or photo if taken		Check if GO not analyzed for Chrysotile
				Primary	Total	Length	Width		LA	OA	CH	NAM				Photo	EDXA (spectrum saved)	
	B16	G4-4	ND															
		G5-4																
8		H5-4																
	A17	E4-1																
		E5-1																
		F3-1																
		F4-1																
		F5-1																
		G4-1																
		H4-1																
16		K4-1																
													HK 10/27/17					

Analyst: D. Kent

Date: 10/27/17

0/11

TD

TLF-12.01
Effective Date: 07/03/2014

TEM Asbestos Structure Count Bench Sheet

Laboratory Name	ESATR8
Site or Project Name	Libby 08BC [OU3]
Client	USEPA Region 8
Chain of Custody Number	240917JP01
Lab Job Number	A170500
Lab Sample ID	A170500-01
Client Sample Number	CV-00058
Tag	AL1
Lab Receipt Date	09/29/2017
Analysis Method	TEM-ISO
Sample Matrix	Air
Sample Type (field, blank, etc.)	Field sample
QC Type	Not QC
Analysis Status	Analyzed
Prepared By	D. Kent
Preparation Date	10/03/2017
Volume (L) or Area (cm²)	40
Lab Comments	
Grid Prep Acceptable? Y or N (explain)	

Circle Prep Type: Direct Indirect Indirect-Ashed	Direct
Loose Material in cowl?	Y N — N
Est. Filter Particulate Loading (%)	3
Instrument	JEOL JEM-1011 (C24)
Voltage (kV)	100
Magnification (X)	5,000
Primary Filter Area (mm²)	385
Primary Filter Pore Size (µm)	0.8
Sec Filter Area (mm²)	-
Sec Filter Pore Size (µm)	-
Grid Opening Area (mm²)	0.0103
Number of Grids Prepared	3
Archive Filter(s) Location	ESATR8
Grid Storage Location	ESATR8
Grid Box	A160
Grid Slots	B4, A5, B5
Filter Type	MCE

Minimum Aspect Ratio	3:1
Minimum Length (µm)	> 5
Minimum Width (µm)	0.25
Max # Structures	25
Max # Grid Openings	163
Target Analytical Sensitivity (s/cc)	0.011
# of GO's to Reach Target AS	85
GO Traverse Direction (V or H)	H
GO Orientation (Sketch letter F)	F, F

F-Factor Calculation (if applicable)

Indirect Fraction Primary Filter	-
Analysis Aliquot 1 (mL)	-
Analysis Volume 1 (ml)	-
Indirect Fraction Secondary Filter	-
Analysis Aliquot 2 (mL)	-
Analysis Volume 2 (mL)	-
Analysis Aliquot 3 (mL)	-
Analysis Volume 3 (mL)	-
F-Factor	1

GO #	Grid	Grid Opening	Structure Type (ND, F, B, CD, CB, CF, MD, etc.)	Number of Structures		Structure Dimensions (µm)		ID Method (ADX, CD, NAM, etc.)	Mineral Class (check one)				Sketch/ Comments	Mineral ID (WRTA, AC, TR, AT, AM, AN, CH, CR, PY, OT, UN)	EDXA Observation (NaK, NaX, XK, XX, NA)	Record number of spectrum or photo if taken		Check if GO not analyzed for Chrysotile
				Primary	Total	Length	Width		LA	OA	CH	NAM				Photo	EDXA (spectrum saved)	
	B4	C4-1	ND															
		C4-3																
		C4-4																
		C4-6																
		E4-1																

0/5

Analyst: D. Kent

5/88

Date: 10/04/17

DM

TEM Asbestos Structure Count Bench Sheet

QC Type: Not QC

Lab Job Number: A170500 | Client Sample Number: CV-00058 | Lab Sample ID: A170500-01

GO #	Grid	Grid Opening	Structure Type (ND, F, B, CD, CB, CF, MD, etc.)	Number of Structures: Primary	Number of Structures: Total	Structure Dimensions (µm): Length	Structure Dimensions (µm): Width	ID Method (ADX, CD, NAM, etc.)	Mineral Class (check one): LA	OA	CH	NAM	Sketch/ Comments	Mineral ID (WRTA, AC, TR, AT, AM, AN, CH, CR, PY, OT, UN)	EDXA Observation (NaK, NaX, XK, XX, NA)	Record number of spectrum or photo if taken: Photo	EDXA (spectrum saved)	Check if GO not analyzed for Chrysotile
4	B4	E4-3	B	1	1	6.8	0.3	ADX	X					WRTA	NaK	568	1-WRTA	
		E4-4	ND															
		E4-6																
		E5-1																
		E5-3																
		E5-4																
12		E5-6																
		F3-1																
		F3-3																
		F3-4																
		F3-6											2					
		F4-1	CD33	2														
			CF		2	9	0.9	ADX	X					WRTA	NaK		2-WRTA	
			CF		0	7.2	0.2	ADX	X				Not PCME	WRTA	XK	OK TDI 2/1/18		
			CF		0	26	0.9	ADX	X				XNCGBLD	WRTA	NaK	OK		

Analyst: D. Kent

Date: 10/04/17

2/12

TDI

TEM Asbestos Structure Count Bench Sheet

QC Type: Not QC

Lab Job Number: A170500 ✓ Client Sample Number: CV-00058 ✓ Lab Sample ID: A170500-01 ✓

GO #	Grid	Grid Opening	Structure Type (ND, F, B, CD, CB, CF, MD, etc.)	Number of Structures: Primary	Number of Structures: Total	Structure Dimensions (µm): Length	Structure Dimensions (µm): Width	ID Method (ADX, CD, NAM, etc.)	Mineral Class (check one): LA	Mineral Class: OA	Mineral Class: CH	Mineral Class: NAM	Sketch/ Comments	Mineral ID (WRTA, AC, TR, AT, AM, AN, CH, CR, PY, OT, UN)	EDXA Observation (NaK, NaX, XK, XX, NA)	Record number of spectrum or photo if taken: Photo	Record number of spectrum or photo if taken: EDXA (spectrum saved)	Check if GO not analyzed for Chrysotile
	B4	F4-3	ND															
		F4-4																
20		F4-6																
		F5-1																
		F5-3																
		F5-4																
		F5-6																
		G2-3																
		G2-6																
		G3-3																
		G3-6																
		G4-1																
		G4-3																
		G4-4																
32		G4-6																

Analyst: D. Kent ✓ Date: 10/05/17 ✓

0/15

VTDR

TEM Asbestos Structure Count Bench Sheet

QC Type: Not QC

Lab Job Number: A170500   Client Sample Number: CV-00058   Lab Sample ID: A170500-01

GO #	Grid	Grid Opening	Structure Type (ND, F, B, CD, CB, CF, MD, etc.)	Number of Structures		Structure Dimensions (µm)		ID Method (ADX, CD, NAM, etc.)	Mineral Class (check one)				Sketch/ Comments	Mineral ID (WRTA, AC, TR, AT, AM, AN, CH, CR, PY, OT, UN)	EDXA Observation (NaK, NaX, XK, XX, NA)	Record number of spectrum or photo if taken		Check if GO not analyzed for Chrysotile
				Primary	Total	Length	Width		LA	OA	CH	NAM				Photo	EDXA (spectrum saved)	
	B4	G5-1	ND															
		G5-3																
		G5-4																
		G5-6																
		H4-1																
		H4-3																
		H4-4																
		H4-6																
		K4-1																
		K4-3																
		K4-4	F	3	3	9.8	0.3	ADX	X					WRTA	NaK		3-WRTA	
44		K4-6	ND															
	A5	C3-1																
		C3-3																
		C3-4																

Analyst: D. Kent   Date: 10/05/17

1/15

TLF-12.01
Effective Date: 07/03/2014

TEM Asbestos Structure Count Bench Sheet

QC Type: Not QC

Lab Job Number: A170500 ✓ Client Sample Number: CV-00058 ✓ Lab Sample ID: A170500-01 ✓

GO #	Grid	Grid Opening	Structure Type (ND, F, B, CD, CB, CF, MD, etc.)	Number of Structures		Structure Dimensions (µm)		ID Method (ADX, CD, NAM, etc.)	Mineral Class (check one)				Sketch/ Comments	Mineral ID (WRTA, AC, TR, AT, AM, AN, CH, CR, PY, OT, UN)	EDXA Observation (NaK, NaX, XK, XX, NA)	Record number of spectrum or photo if taken		Check if GO not analyzed for Chrysotile
				Primary	Total	Length	Width		LA	OA	CH	NAM				Photo	EDXA (spectrum saved)	
48	A5	C3-6	ND															
		C4-1																
		C4-3																
		C4-4																
		C4-6																
		E3-1																
		E3-3																
		E3-4																
		E3-6																
		✓E4-1	F ✓	4 ✓	4 ✓	5.2 ✓	0.3 ✓	ADX	X ✓					WRTA ✓	NaK ✓		4-WRTA	
		E4-3	ND															
		E4-4																
		E4-6																
		E5-1																
		E5-3																

Analyst: D. Kent ✓ Date: 10/05/17 ✓

1/15 ✓

VTDM

TLF-12.01
Effective Date: 07/03/2014

TEM Asbestos Structure Count Bench Sheet

QC Type: Not QC

Lab Job Number: A170500 ✓ Client Sample Number: CV-00058 ✓ Lab Sample ID: A170500-01 ✓

GO #	Grid	Grid Opening	Structure Type (ND, F, B, CD, CB, CF, MD, etc.)	Number of Structures		Structure Dimensions (µm)		ID Method (ADX, CD, NAM, etc.)	Mineral Class (check one)				Sketch/ Comments	Mineral ID (WRTA, AC, TR, AT, AM, AN, CH, CR, PY, OT, UN)	EDXA Observation (NaK, NaX, XK, XX, NA)	Record number of spectrum or photo if taken		Check if GO not analyzed for Chrysotile
				Primary	Total	Length	Width		LA	OA	CH	NAM				Photo	EDXA (spectrum saved)	
	A5	E5-4	ND															
64		E5-6																
		F3-1																
		F3-3																
		F3-4																
		F3-6																
		F4-1																
		F4-3																
		F4-4																
		F4-6																
		F5-1																
		F5-3																
		F5-4																
		F5-6																
		G3-1																

Analyst: D. Kent ✓ Date: 10/05/17

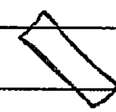
0/15 ✓

VTDL

TEM Asbestos Structure Count Bench Sheet

QC Type: Not QC

Lab Job Number: A170500 Client Sample Number: CV-00058 Lab Sample ID: A170500-01

GO #	Grid	Grid Opening	Structure Type (ND, F, B, CD, CB, CF, MD, etc.)	Number of Structures		Structure Dimensions (µm)		ID Method (ADX, CD, NAM, etc.)	Mineral Class (check one)				Sketch/ Comments	Mineral ID (WRTA, AC, TR, AT, AM, AN, CH, CR, PY, OT, UN)	EDXA Observation (NaK, NaX, XK, XX, NA)	Record number of spectrum or photo if taken		Check if GO not analyzed for Chrysotile
				Primary	Total	Length	Width		LA	OA	CH	NAM				Photo	EDXA (spectrum saved)	
	A5	G3-3	ND															
		G3-4																
80		G3-6																
		F6-1																
		F6-3																
		F6-4																
		F6-6	B	5	5	6.8	1.4	ADX	X					WRTA	NaK		5-WRTA	
		H3-1	ND															
		H3-3																
		H3-4																
88		H3-6																

Analyst: D. Kent Date: 10/05/17

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TDM

TEM Asbestos Structure Count Bench Sheet

Laboratory Name	ESATR8
Site or Project Name	Libby 08BC [OU3]
Client	USEPA Region 8
Chain of Custody Number	240917JP01
Lab Job Number	A170500
Lab Sample ID	A170500-05
Client Sample Number	CV-00062
Tag	AL1
Lab Receipt Date	09/29/2017
Analysis Method	TEM-ISO
Sample Matrix	Air
Sample Type (field, blank, etc.)	Field sample
QC Type	Not QC
Analysis Status	Analyzed
Prepared By	D. Kent
Preparation Date	10/03/2017
Volume (L) or Area (cm²)	40
Lab Comments	
Grid Prep Acceptable? Y or N (explain)	Y

Circle Prep Type: Direct Indirect Indirect-Ashed	Direct
Loose Material in cowl?	Y N — N
Est. Filter Particulate Loading (%)	4
Instrument	JEOL JEM-1011 (C24)
Voltage (kV)	100
Magnification (X)	5,000
Primary Filter Area (mm²)	385
Primary Filter Pore Size (µm)	0.8
Sec Filter Area (mm²)	-
Sec Filter Pore Size (µm)	-
Grid Opening Area (mm²)	0.0103
Number of Grids Prepared	3
Archive Filter(s) Location	ESATR8
Grid Storage Location	ESATR8
Grid Box	A160
Grid Slots	A7, B7, C7
Filter Type	MCE

Minimum Aspect Ratio	3:1
Minimum Length (µm)	> 5
Minimum Width (µm)	0.25
Max # Structures	25
Max # Grid Openings	163
Target Analytical Sensitivity (s/cc)	0.011
# of GO's to Reach Target AS	85
GO Traverse Direction (V or H)	H
GO Orientation (Sketch letter F)	F, F

F-Factor Calculation (if applicable)

Indirect Fraction Primary Filter	-
Analysis Aliquot 1 (mL)	-
Analysis Volume 1 (ml)	-
Indirect Fraction Secondary Filter	-
Analysis Aliquot 2 (mL)	-
Analysis Volume 2 (mL)	-
Analysis Aliquot 3 (mL)	-
Analysis Volume 3 (mL)	-
F-Factor	1

NL
√ 5/90
DVC

15/85

GO #	Grid	Grid Opening	Structure Type (ND, F, B, CD, CB, CF, MD, etc.)	Number of Structures: Primary	Number of Structures: Total	Structure Dimensions (µm): Length	Structure Dimensions (µm): Width	ID Method (ADX, CD, NAM, etc.)	Mineral Class: LA	Mineral Class: OA	Mineral Class: CH	Mineral Class: NAM	Sketch/ Comments	Mineral ID (WRTA, AC, TR, AT, AM, AN, CH, CR, PY, OT, UN)	EDXA Observation (NaK, NaX, XK, XX, NA)	Photo	EDXA (spectrum saved)	Check if GO not analyzed for Chrysotile
1	A7	G2-3	NP															
		F2-6	B	1	1	17	2	ADX	✓					WRTA	NaK		1-WRTA	
		F2-3	B	2	2	71	3	ADX	✓					WRTA	NaK		2-WRTA	
		E2-6	NP															
		E2-3																

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Analyst: N. DelHierro

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Date: 10/6/17

TDM

TEM Asbestos Structure Count Bench Sheet

QC Type: Not QC

Lab Job Number: A170500

Client Sample Number: CV-00062

Lab Sample ID: A170500-05

GO #	Grid	Grid Opening	Structure Type (ND, F, B, CD, CB, CF, MD, etc.)	Number of Structures: Primary	Number of Structures: Total	Structure Dimensions (µm): Length	Structure Dimensions (µm): Width	ID Method (ADX, CD, NAM, etc.)	Mineral Class (check one): LA	Mineral Class (check one): OA	Mineral Class (check one): CH	Mineral Class (check one): NAM	Sketch/ Comments	Mineral ID (WRTA, AC, TR, AT, AM, AN, CH, CR, PY, OT, UN)	EDXA Observation (NaK, NaX, XK, XX, NA)	Record number of spectrum or photo if taken: Photo	Record number of spectrum or photo if taken: EDXA (spectrum saved)	Check if GO not analyzed for Chrysotile
	A7	C2-6	B	3	3	5.2	0.5	ADX	✓					WRTA	NaK		3-WRTA	
		K3-3	ND															
		H3-6	B	4	4	5.1	0.7	ADX	✓					WRTA	NaK		4-WRTA	
		H3-3	B	0	0	42	2	ADX	✓				XNCGBLD	WRTA	NaK			
		G3-6	ND															
		G3-3																
		F3-6																
		F3-3																
		E3-6																
		E3-3																
		C3-6																
		K4-3	B	5	5	10	1.3	ADX	✓					WRTA	NaK		5-WRTA	
		H4-6	ND															
		H4-3																
		G4-6																

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Analyst: N. DelHierro

Date: 10/9/17

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TLF-12.01
Effective Date: 07/03/2014

TEM Asbestos Structure Count Bench Sheet

QC Type: Not QC

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Lab Job Number: A170500

Client Sample Number: CV-00062

Lab Sample ID: A170500-05

GO #	Grid	Grid Opening	Structure Type (ND, F, B, CD, CB, CF, MD, etc.)	Number of Structures		Structure Dimensions (µm)		ID Method (ADX, CD, NAM, etc.)	Mineral Class (check one)				Sketch/ Comments	Mineral ID (WRTA, AC, TR, AT, AM, AN, CH, CR, PY, OT, UN)	EDXA Observation (NaK, NaX, XK, XX, NA)	Record number of spectrum or photo if taken		Check if GO not analyzed for Chrysotile
				Primary	Total	Length	Width		LA	OA	CH	NAM				Photo	EDXA (spectrum saved)	
	A7	G4-3	ND															
		F4-6																
		F4-3																
		E4-6	B	6	6	13	1	ADX	✓					WRTA	NaK			
		E4-3	ND															
		C4-6																
		C4-3																
		B4-6	B	0	0	19.5	0.5	ADX	✓				XNCGBLD	WRTA	NaK			
		H5-6	ND															
		H5-3	B	0	0	31	1.3	ADX	✓				XNCGBLD	WRTA	NaK			
		G5-6	ND															
		G5-3																
		F5-6																
		F5-3																
		E5-6																

1/15

Analyst: N.DelHierro

Date: 10/9/17

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JDM

TEM Asbestos Structure Count Bench Sheet

QC Type: Not QC

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Lab Job Number: A170500

Client Sample Number: CV-00062

Lab Sample ID: A170500-05

GO #	Grid	Grid Opening	Structure Type (ND, F, B, CD, CB, CF, MD, etc.)	Number of Structures: Primary	Number of Structures: Total	Structure Dimensions (µm): Length	Structure Dimensions (µm): Width	ID Method (ADX, CD, NAM, etc.)	Mineral Class (check one): LA	OA	CH	NAM	Sketch/ Comments	Mineral ID (WRTA, AC, TR, AT, AM, AN, CH, CR, PY, OT, UN)	EDXA Observation (NaK, NaX, XK, XX, NA)	Record number of spectrum or photo if taken: Photo	EDXA (spectrum saved)	Check if GO not analyzed for Chrysotile
	A7	E5-3	ND															
		C5-6																
		H6-4																
		H6-1	B	7	7	22	1	ADX	✓				X6BLD	WRTA	NaK			
		G6-4	ND															
		G6-1	MD 11	8														
			MB		8	7.5	0.6	ADX	✓					WRTA	NaK			
		F6-4	ND															
		F6-1																
		E6-4																
	B7	H2-3																
		G2-6																
		G2-3																
		F2-6																
		F2-3																

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Analyst: N. DelHierro

Date: 10/9/17

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TLF-12.01
Effective Date: 07/03/2014

TEM Asbestos Structure Count Bench Sheet

QC Type: Not QC

Lab Job Number: A170500 ✓ Client Sample Number: CV-00062 ✓ Lab Sample ID: A170500-05 ✓

GO #	Grid	Grid Opening	Structure Type (ND, F, B, CD, CB, CF, MD, etc.)	Number of Structures Primary	Number of Structures Total	Structure Dimensions (µm) Length	Structure Dimensions (µm) Width	ID Method (ADX, CD, NAM, etc.)	Mineral Class (check one) LA	OA	CH	NAM	Sketch/ Comments	Mineral ID (WRTA, AC, TR, AT, AM, AN, CH, CR, PY, OT, UN)	EDXA Observation (NaK, NaX, XK, XX, NA)	Record number of spectrum or photo if taken: Photo	EDXA (spectrum saved)	Check if GO not analyzed for Chrysotile
	B7	E2-6	ND															
		E2-3																
		C2-6																
		K3-3																
		H3-6																
		H3-3	B	9	9	20	0.7	ADX	✓				XGBLD	WRTA	NaK			
		G3-6	ND															
		G3-3																
		F3-6																
		F3-3																
		E3-6																
		E3-3																
		C3-6	B	10	10	41	1	ADX	✓					WRTA	NaK	0572	10-WRTA	
		C3-3	ND															
		B3-6																

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Analyst: N. DelHierro ✓ Date: 10/9/17 ✓

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TEM Asbestos Structure Count Bench Sheet

QC Type: Not QC

Lab Job Number: A170500

Client Sample Number: CV-00062

Lab Sample ID: A170500-05

GO #	Grid	Grid Opening	Structure Type (ND, F, B, CD, CB, CF, MD, etc.)	Number of Structures		Structure Dimensions (µm)		ID Method (ADX, CD, NAM, etc.)	Mineral Class (check one)				Sketch/ Comments	Mineral ID (WRTA, AC, TR, AT, AM, AN, CH, CR, PY, OT, UN)	EDXA Observation (NaK, NaX, XK, XX, NA)	Record number of spectrum or photo if taken		Check if GO not analyzed for Chrysotile
				Primary	Total	Length	Width		LA	OA	CH	NAM				Photo	EDXA (spectrum saved)	
	B7	K4-3	B	11	11	25	0.7	ADX	✓				XGBLD	WRTA	NaK			
			B	12	12	6	1	ADX	✓					WRTA	NaK			
		H4-6	ND															
		H4-3																
		G4-6																
		G4-3																
		F4-6																
		F4-3	B	13	13	61	2	ADX	✓					WRTA	NaK			
		E4-6	ND															
		E4-3																
		C4-6																
		H5-6																
		H5-3																
		G5-6																
		G5-3																

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Analyst: N. DelHierro

Date: 10/9/17

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TLF-12.01
Effective Date: 07/03/2014

TEM Asbestos Structure Count Bench Sheet

QC Type: Not QC

Lab Job Number: A170500 ✓ Client Sample Number: CV-00062 ✓ Lab Sample ID: A170500-05 ✓

GO #	Grid	Grid Opening	Structure Type (ND, F, B, CD, CB, CF, MD, etc.)	Number of Structures		Structure Dimensions (µm)		ID Method (ADX, CD, NAM, etc.)	Mineral Class (check one)				Sketch/ Comments	Mineral ID (WRTA, AC, TR, AT, AM, AN, CH, CR, PY, OT, UN)	EDXA Observation (NaK, NaX, XK, XX, NA)	Record number of spectrum or photo if taken		Check if GO not analyzed for Chrysotile
				Primary	Total	Length	Width		LA	OA	CH	NAM				Photo	EDXA (spectrum saved)	
	B7	FS-6	ND															
		FS-3	B	14	14	18	1.2	ADX	✓				XGBLD	WRTA	NaK			
		ES-6	ND															
		ES-3																
		CS-6																
		CS-3	MD 11	15														
			MB		15	6.8	0.4	ADX	✓					WRTA	NaK			
85		B5-6	ND															

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Analyst: N. DelHierro ✓ Date: 10/9/17 ✓

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TLF-12.01
Effective Date: 07/03/2014

TEM Asbestos Structure Count Bench Sheet

Laboratory Name	ESATR8
Site or Project Name	Libby 08BC [OU3]
Client	USEPA Region 8
Chain of Custody Number	250917MB02
Lab Job Number	A170569
Lab Sample ID	A170569-03
Client Sample Number	CV-00088
Tag	AL1
Lab Receipt Date	11/28/2017
Analysis Method	TEM-ISO
Sample Matrix	Air
Sample Type (field, blank, etc.)	Field Sample
QC Type	Not QC
Analysis Status	Analyzed
Prepared By	D. Kent
Preparation Date	11/29/2017
Volume (L) or Area (cm²)	60
Lab Comments	
Grid Prep Acceptable? Y or N (explain)	Y

Circle Prep Type: Direct Indirect Indirect-Ashed	Direct
Loose Material in cowl?	Y N — N
Est. Filter Particulate Loading (%)	3
Instrument	JEOL JEM-1011 (C24)
Voltage (kV)	100
Magnification (X)	5,000
Primary Filter Area (mm²)	385
Primary Filter Pore Size (µm)	0.8
Sec Filter Area (mm²)	-
Sec Filter Pore Size (µm)	-
Grid Opening Area (mm²)	0.0103
Number of Grids Prepared	3
Archive Filter(s) Location	ESATR8
Grid Storage Location	ESATR8
Grid Box	B6
Grid Slots	C17, A18, B18
Filter Type	MCE

Minimum Aspect Ratio	3:1
Minimum Length (µm)	> 5
Minimum Width (µm)	0.25
Max # Structures	25
Max # Grid Openings	64
Target Analytical Sensitivity (s/cc)	0.022
# of GO's to Reach Target AS	29
GO Traverse Direction (V or H)	H
GO Orientation (Sketch letter F)	F, F

F-Factor Calculation (if applicable)

Indirect Fraction Primary Filter	-
Analysis Aliquot 1 (mL)	-
Analysis Volume 1 (ml)	-
Indirect Fraction Secondary Filter	-
Analysis Aliquot 2 (mL)	-
Analysis Volume 2 (mL)	-
Analysis Aliquot 3 (mL)	-
Analysis Volume 3 (mL)	-
F-Factor	1

GO #	Grid	Grid Opening	Structure Type (ND, F, B, CD, CB, CF, MD, etc.)	Number of Structures Primary	Number of Structures Total	Structure Dimensions (µm) Length	Structure Dimensions (µm) Width	ID Method (ADX, CD, NAM, etc.)	Mineral Class LA	OA	CH	NAM	Sketch/ Comments	Mineral ID (WRTA, AC, TR, AT, AM, AN, CH, CR, PY, OT, UN)	EDXA Observation (NaK, NaX, XK, XX, NA)	Photo	EDXA (spectrum saved)	Check if GO not analyzed for Chrysotile
1	C17	G2-6	ND															
		F2-6																
		H3-3																
		F3-3																
		C3-6																

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0/5 Analyst: N. DelHierro

Date: 12/8/17

250917MB02_ESATR8_A170569_TEM-ISO_C0

TDM

TEM Asbestos Structure Count Bench Sheet

QC Type: Not QC

Lab Job Number: A170569 ✓ Client Sample Number: CV-00088 ✓ Lab Sample ID: A170569-03 ✓

GO #	Grid	Grid Opening	Structure Type (ND, F, B, CD, CB, CF, MD, etc.)	Number of Structures		Structure Dimensions (µm)		ID Method (ADX, CD, NAM, etc.)	Mineral Class (check one)				Sketch/ Comments	Mineral ID (WRTA, AC, TR, AT, AM, AN, CH, CR, PY, OT, UN)	EDXA Observation (NaK, NaX, XK, XX, NA)	Record number of spectrum or photo if taken		Check if GO not analyzed for Chrysotile
				Primary	Total	Length	Width		LA	OA	CH	NAM				Photo	EDXA (spectrum saved)	
	C17	C4-1	ND															
		F4-1																
		K4-3																
		G4-3																
		K5-4																
		H5-4																
		F5-4																
		E5-1																
		F5-6																
		G6-4																
	A18	F2-1																
		F2-6																
		E2-3																
		C3-4																
		H3-4																

Analyst: N. Del Hierro ✓ Date: 12/8/17 ✓

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✓ TDM

TLF-12.01
Effective Date: 07/03/2014

TEM Asbestos Structure Count Bench Sheet

QC Type: Not QC

Lab Job Number: A170569 ✓ Client Sample Number: CV-00088 ✓ Lab Sample ID: A170569-03 ✓

GO #	Grid	Grid Opening	Structure Type (ND, F, B, CD, CB, CF, MD, etc.)	Number of Structures		Structure Dimensions (µm)		ID Method (ADX, CD, NAM, etc.)	Mineral Class (check one)				Sketch/ Comments	Mineral ID (WRTA, AC, TR, AT, AM, AN, CH, CR, PY, OT, UN)	EDXA Observation (NaK, NaX, XK, XX, NA)	Record number of spectrum or photo if taken		Check if GO not analyzed for Chrysotile
				Primary	Total	Length	Width		LA	OA	CH	NAM				Photo	EDXA (spectrum saved)	
	A18	K3-6	ND															
		G3-6																
		K4-1																
		H4-1																
		F4-4																
		B4-1																
		C4-3																
		F5-4																
19		C5-4																

Analyst: N. DelHierro ✓ Date: 12/8/17 ✓

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TEM Asbestos Structure Count Bench Sheet

Laboratory Name	ESATR8
Site or Project Name	Libby 08BC [OU3]
Client	USEPA Region 8
Chain of Custody Number	250917JR1
Lab Job Number	A170531
Lab Sample ID	A170531-07
Client Sample Number	CV-00118
Tag	AL1
Lab Receipt Date	10/23/2017
Analysis Method	TEM-ISO
Sample Matrix	Air
Sample Type (field, blank, etc.)	Field Sample
QC Type	Not QC
Analysis Status	Analyzed
Prepared By	N. DelHierro
Preparation Date	10/24/2017
Volume (L) or Area (cm²)	60
Lab Comments	
Grid Prep Acceptable? Y or N (explain)	Y

Circle Prep Type: Direct Indirect Indirect-Ashed	Direct
Loose Material in cowl?	Y N — N
Est. Filter Particulate Loading (%)	5
Instrument	JEOL JEM-1011 (C24)
Voltage (kV)	100
Magnification (X)	5,000
Primary Filter Area (mm²)	385
Primary Filter Pore Size (µm)	0.8
Sec Filter Area (mm²)	-
Sec Filter Pore Size (µm)	-
Grid Opening Area (mm²)	0.0103
Number of Grids Prepared	3
Archive Filter(s) Location	ESATR8
Grid Storage Location	ESATR8
Grid Box	B5
Grid Slots	B9, C9, A10
Filter Type	MCE

Minimum Aspect Ratio	3:1
Minimum Length (µm)	> 5
Minimum Width (µm)	0.25
Max # Structures	25
Max # Grid Openings	64
Target Analytical Sensitivity (s/cc)	0.022
# of GO's to Reach Target AS	29
GO Traverse Direction (V or H)	H
GO Orientation (Sketch letter F)	F, F
F-Factor Calculation (if applicable)	
Indirect Fraction Primary Filter	-
Analysis Aliquot 1 (mL)	-
Analysis Volume 1 (ml)	-
Indirect Fraction Secondary Filter	-
Analysis Aliquot 2 (mL)	-
Analysis Volume 2 (mL)	-
Analysis Aliquot 3 (mL)	-
Analysis Volume 3 (mL)	-
F-Factor	1

GO #	Grid	Grid Opening	Structure Type (ND, F, B, CD, CB, CF, MD, etc.)	Number of Structures: Primary	Number of Structures: Total	Structure Dimensions (µm): Length	Structure Dimensions (µm): Width	ID Method (ADX, CD, NAM, etc.)	Mineral Class (check one): LA	OA	CH	NAM	Sketch/ Comments	Mineral ID (WRTA, AC, TR, AT, AM, AN, CH, CR, PY, OT, UN)	EDXA Observation (NaK, NaX, XK, XX, NA)	Record number of spectrum or photo if taken: Photo	EDXA (spectrum saved)	Check if GO not analyzed for Chrysotile
	B9	E3-1	ND															
	↓	E3-6	↓															
	↓	E4-1	↓															
	↓	E4-6	↓															
	↓	E5-1	↓															

Analyst: D. Kent

Date: 11/03/17

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TEM Asbestos Structure Count Bench Sheet

QC Type: Not QC

Page 2 of 3

Lab Job Number: A170531

Client Sample Number: CV-00118

Lab Sample ID: A170531-07

GO #	Grid	Grid Opening	Structure Type (ND, F, B, CD, CB, CF, MD, etc.)	Number of Structures		Structure Dimensions (µm)		ID Method (ADX, CD, NAM, etc.)	Mineral Class (check one)				Sketch/ Comments	Mineral ID (WRTA, AC, TR, AT, AM, AN, CH, CR, PY, OT, UN)	EDXA Observation (NaK, NaX, XK, XX, NA)	Record number of spectrum or photo if taken		Check if GO not analyzed for Chrysotile
				Primary	Total	Length	Width		LA	OA	CH	NAM				Photo	EDXA (spectrum saved)	
	B9	F3-1	ND															
		F3-6																
		F4-1																
		F4-6																
		F5-6																
		H3-1																
		H3-6																
		H4-6																
		H5-1																
		H6-1																
	C9	C3-1																
		C3-6																
		C4-1																
		C4-6																
		C5-6																

Analyst: D. Kent

Date: 11/03/17

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TDM

TEM Asbestos Structure Count Bench Sheet

QC Type: Not QC Page 3 of 3

Lab Job Number: A170531 Client Sample Number: CV-00118 Lab Sample ID: A170531-07

GO #	Grid	Grid Opening	Structure Type (ND, F, B, CD, CB, CF, MD, etc.)	Number of Structures Primary	Number of Structures Total	Structure Dimensions (µm) Length	Structure Dimensions (µm) Width	ID Method (ADX, CD, NAM, etc.)	Mineral Class (check one) LA	OA	CH	NAM	Sketch/ Comments	Mineral ID (WRTA, AC, TR, AT, AM, AN, CH, CR, PY, OT, UN)	EDXA Observation (NaK, NaX, XK, XX, NA)	Record number of spectrum or photo if taken: Photo	EDXA (spectrum saved)	Check if GO not analyzed for Chrysotile
	C9	E3-1	ND															
		E4-1																
		E4-6																
		E5-1																
		E5-6																
		G3-1																
		G3-6																
		G4-1																
		G4-6																
30		G5-6																
													DK 11/3/17					

Analyst: D. Kent Date: 11/03/17

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ATTACHMENT C
TEM CONSISTENCY REVIEW AND DATA TRANSFER VERIFICATION REPORTS FOR 2018 WINTER HOOKING/SKIDDING ACTIVITY-BASED SAMPLING STUDY

Project/Dataset Description: Libby Asbestos Superfund Site, Operable Unit 3 (OU3) 2018 Winter Hooking/Skidding Activity-Based Sampling Study – Air

SUMMARY OF FINDINGS AND DATA QUALITY IMPLICATIONS

A verification of the Libby Asbestos Superfund Site (Site), Operable Unit 3 (OU3) 2018 Winter Hooking/Skidding Activity-Based Sampling (ABS) Study air analyses was performed. Samples were collected and analyzed in accordance with the governing sampling and analysis plan/quality assurance project plan (SAP/QAPP), *Winter Hooking/Skidding ABS Study*, Revision 0 (Stantec 2018), an addendum to the *SAP/QAPP 2016 Woodstove Ash and Hooking/Skidding ABS Investigation,* Revision 1 (MWH 2016). Air samples were analyzed by transmission electron microscopy (TEM) in accordance with International Standard Organization (ISO) method 10312:1995(E), *Determination of asbestos fibres-direct-transfer transmission electron microscopy method* (ISO 1995). This verification effort was based on the Libby OU3 project database and the final laboratory reports as provided by the analytical laboratories in basic accordance with standard operating procedure (SOP) EPA-LIBBY-09 (Revision 2), *SOP for Transmission Electron Microscopy Data Review and Data Entry Verification* (EPA 2012).

The minimum verification frequency specified in the SAP/QAPP is 10%. Due to the low number of analyses in the study the Data Verifier elected to verify 100% of the analyses, rather than 10%. Thus, all five air analyses were selected for verification.

Any issues identified in the verification process were categorized in the following manner:

> **Critical error**: An error identified in a critical data field which resulted in an error in the calculation of the achieved analytical sensitivity, concentration, or structure count. Critical data fields include, but are not limited to, effective area of the filter, number of grid openings examined, area of a grid opening, sample quantity (e.g., mass, volume, area), number of structures observed, and indirect preparation inputs.
>
> **Potential critical error**: An error identified in a critical data field which does not result in an error in the calculation of the achieved analytical sensitivity, concentration, or structure count.
>
> **Non-critical discrepancy**: A discrepancy identified in a non-critical data field that does not impact the calculation of the achieved analytical sensitivity, concentration, or structure count. Non-critical data fields include, but are not limited to, preparation details (e.g., number of grids prepared, prepared by) and analytical details (e.g., analyst name, analysis date).

Data verification includes checking that results have been transferred correctly from the original hand-written, hard copy analytical laboratory documentation to the electronic data deliverable (EDD). Consistency checks were performed for all analyses to ensure that the reported raw structure data were consistent with the analytical method and that applicable analytical SOPs and Libby-specific laboratory method modifications had been followed. Additionally, all calculated values in the EDD were verified based on raw data inputs to confirm the transfer of data from the EDD to the database was performed properly.

No errors or discrepancies were identified during this verification effort.

DATA VERIFICATION COORDINATOR REVIEW

The Data Verification Coordinator (DVC) is required to perform a review of a minimum of 5% of the analyses verified to ensure that any potential issues were identified correctly. This resulted in a check of one TEM-ISO analysis; no deficiencies were noted.

RECOMMENDATIONS FOR FUTURE REVIEW AND VERIFICATION

There is no need to perform future review or verification efforts for this dataset because all analyses were verified, and no errors or discrepancies were identified.

Data Verifier: Tyler D Miller ***Date:*** 6/22/2018

Data Verification Coordinator: Natalie Ross ***Date:*** 6/22/2018

Verification Data Manager*: Natalie Ross ***Date:*** 6/22/2018

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

- Signatures for the Data Verifier, Data Verification Coordinator, and Verification Data Manager have been added to the verification summary report.

TEM-ISO SELECTION

Lab	Analyst Initials	Number of TEM-ISO Analyses			Number of TEM-ISO Analyses Selected for Review[1]		
		Detect	Non-Detect	Total	Detect	Non-Detect	Total
ESATR8	D.K.	1	1	2	1	1	2
	N.D.	1	2	3	1	2	3
	Total	**2**	**3**	**5**	**2**	**3**	**5**

CONSISTENCY REVIEW RESULTS

Number of analyses reviewed: 5 of 5 (100% of total analyses selected)
Number of analyses with recording issues identified[2]: 0 (0% of total analyses reviewed)

DATA TRANSFER RESULTS

Number of analyses verified: 5 of 5 (100% of total analyses selected)
Number of analyses with data transfer issues identified: 5 (0% of total analyses reviewed)

COMMENTS

Attachments 1 and 2 contain the analytical and structure information for the TEM verification effort. Attachment 3 contains the data packages (e.g., benchsheets) that were used for this verification effort, including the data verifier's notes.

REFERENCES

EPA (U.S. Environmental Protection Agency). 2012. *Standard Operating Procedure for TEM Data Review and Data Entry Verification*. SOP EPA-LIBBY-09. Produced by CDM Smith for the U.S. Environmental Protection Agency, Region 8. Revision 2 - September.

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

MWH. 2016. *2016 Woodstove Ash and Hooking/Skidding Activity-Based Sampling Investigation, Sampling and Analysis Plan/Quality Assurance Project Plan.* Libby Asbestos Superfund Site, Operable Unit 3. Revision 1. August 2016.

Stantec. 2018. *Winter Hooking/Skidding ABS Study, Sampling and Analysis Plan/Quality Assurance Project Plan.* Libby Asbestos Superfund Site, Operable Unit 3. February.

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[1] As noted previously, due to the low number of analyses the Data Verifier elected to verify 100% of analyses, rather than the 10% specified in the governing SAP/QAPP.

[2] Recording issues are discrepancies associated with the analyst not recording structures in accordance with the analytical method (e.g., structure type, mineral class, structure comments, energy dispersive x-ray analysis [EDXA] observation).

ATTACHMENT 1
DATA SUMMARY OF ANALYTICAL AND RESULT INFORMATION
Libby Asbestos Superfund Site - Operable Unit 3
2018 Winter Hooking/Skidding ABS

DVC - 5% Check	Sample Number	Field QC Type	Scenario/Event	Media	File Revision No	Lab ID	Instrument	Magnification	GO Size	EFA	Air Volume (L)	Receipt Date	Lab Job Number	Lab Sample ID	Number of Grids Prepared	Preparer Name	Preparation Date	Analyst Name	Analysis Date	Preparation Method	Loose Material	Analysis Method	Est Filter Loading (%)	F Factor	Analysis Comments	Recording Rules			Stopping Rules			Grid Openings Examined	Sensitivity (cc^{-1})	PCME LA		PCME OA		PCME CH		Stopping Rule Achieved	Verifier's Company	Verifier's Name	Verified Date	Verification Comment
																										Minimum Aspect Ratio	Minimum Length (µm)	Minimum Width (µm)	Target Sensitivity (cc^{-1})	Max Area Examined (mm^2)	Target N Strucs			Structure Count	Conc. (s/cc)	Structure Count	Conc. (s/cc)	Structure Count	Conc. (s/cc)					
x-NR	WH-10002	Field Sample	Hooking/Skidding ABS	Air	0	ESATR8	JEOL JEM-1011 (C24)	5000	0.0103	385	120	2/15/2018	A180017	A180017-03	3	D. Kent	2/16/2018	D. Kent	2/22/2018	Direct	No	TEM-ISO	4	1	Also analyzed on 2/23/2018	3:1	5	0.25	0.0038	3.4	25	88	0.0035	0	0	0	0	0	0	Sensitivity	CDM Smith	T. Miller	3/21/2018	
	WH-10004	Field Sample	Hooking/Skidding ABS	Air	0	ESATR8	JEOL JEM-1011 (C24)	5000	0.0103	385	120	2/15/2018	A180017	A180017-05	3	D. Kent	2/16/2018	N. DelHierro	2/23/2018	Direct	No	TEM-ISO	3	1		3:1	5	0.25	0.0038	3.4	25	82	0.0038	0	0	0	0	0	0	Sensitivity	CDM Smith	T. Miller	3/21/2018	
	WH-10006	Field Sample	Hooking/Skidding ABS	Air	0	ESATR8	JEOL JEM-1011 (C24)	5000	0.0103	385	120	2/15/2018	A180017	A180017-07	3	D. Kent	2/16/2018	N. DelHierro	2/23/2018	Direct	No	TEM-ISO	3	1		3:1	5	0.25	0.0038	3.4	25	82	0.0038	0	0	0	0	0	0	Sensitivity	CDM Smith	T. Miller	3/21/2018	
	WH-10008	Field Sample	Hooking/Skidding ABS	Air	0	ESATR8	JEOL JEM-1011 (C24)	5000	0.0103	385	120	2/15/2018	A180017	A180017-09	3	D. Kent	2/16/2018	N. DelHierro	2/26/2018	Direct	No	TEM-ISO	3	1		3:1	5	0.25	0.0038	3.4	25	82	0.0038	1	0.0038	0	0	0	0	Sensitivity	CDM Smith	T. Miller	3/21/2018	
	WH-10010	Field Sample	Hooking/Skidding ABS	Air	0	ESATR8	JEOL JEM-1011 (C24)	5000	0.0103	385	120	2/15/2018	A180017	A180017-11	3	D. Kent	2/16/2018	D. Kent	2/26/2018	Direct	No	TEM-ISO	5	1		3:1	5	0.25	0.0038	3.4	25	84	0.0037	1	0.0037	0	0	0	0	Sensitivity	CDM Smith	T. Miller	3/21/2018	

Notes:
% = percent
µm = micrometer
ABS = activity-based sampling
cc^{-1} = per cubic centimeter
EFA = effective filter area
GO = grid opening
ID = identification
ISO = International Organization for Standardization
L = liter
mL = milliliter
mm^2 = square millimeter
s/cc = structures per cubic centimeter
TEM = transmission electron microscopy

ATTACHMENT 2
DATA SUMMARY OF STRUCTURE INFORMATION
Libby Asbestos Superfund Site - Operable Unit 3
2018 Winter Hooking/Skidding ABS

Sample Number	Lab Sample ID	Structure ID	Row Index	Grid	Grid Opening	Structure Type	Primary	Total	Length (µm)	Width (µm)	Aspect Ratio	Mineral Class	Mineral Description	Structure Identification	Sketch	Photo	EDS	Structure Comment	Verifier's Company	Verifier's Name	Date Verified	Verification Comment	DVC - 5%
WH-10002	A180017-03	295870	1	B9	C3-1	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295871	2	B9	C3-3	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295872	3	B9	C3-4	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295873	4	B9	C3-6	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295874	5	B9	C4-1	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295875	6	B9	C4-3	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295876	7	B9	C4-4	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295877	8	B9	C4-6	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295878	9	B9	C5-1	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295879	10	B9	C5-3	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295880	11	B9	C5-4	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295881	12	B9	C5-6	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295882	13	B9	E3-1	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295883	14	B9	E3-3	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295884	15	B9	E3-4	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295885	16	B9	E3-6	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295886	17	B9	E4-1	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295887	18	B9	E4-3	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295888	19	B9	E4-4	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295889	20	B9	E4-6	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295890	21	B9	E5-1	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295891	22	B9	E5-3	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295892	23	B9	E5-4	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295893	24	B9	E5-6	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295894	25	B9	F3-1	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295895	26	B9	F3-3	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295896	27	B9	F3-4	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295897	28	B9	F3-6	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295898	29	B9	F4-1	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295899	30	B9	F4-3	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295900	31	B9	F4-4	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295901	32	B9	F4-6	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295902	33	B9	F5-1	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295903	34	B9	F5-3	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295904	35	B9	F5-4	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295905	36	B9	F5-6	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295906	37	B9	G3-1	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295907	38	B9	G3-3	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295908	39	B9	G3-4	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295909	40	B9	G3-6	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295910	41	B9	G4-1	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295911	42	B9	G4-3	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295912	43	B9	G4-4	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295913	44	B9	G4-6	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295914	45	C9	C3-1	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295915	46	C9	C3-3	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295916	47	C9	C3-4	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295917	48	C9	C3-6	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295918	49	C9	C4-1	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295919	50	C9	C4-3	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295920	51	C9	C4-4	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295921	52	C9	C4-6	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295922	53	C9	C5-1	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295923	54	C9	C5-3	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295924	55	C9	C5-4	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295925	56	C9	C5-6	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295926	57	C9	E3-1	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295927	58	C9	E3-3	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295928	59	C9	E3-4	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295929	60	C9	E3-6	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295930	61	C9	E4-1	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295931	62	C9	E4-3	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295932	63	C9	E4-4	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295933	64	C9	E4-6	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295934	65	C9	E5-1	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295935	66	C9	E5-3	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295936	67	C9	E5-4	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295937	68	C9	E5-6	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295938	69	C9	F3-1	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295939	70	C9	F3-3	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295940	71	C9	F3-4	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295941	72	C9	F3-6	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295942	73	C9	F4-1	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295943	74	C9	F4-3	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295944	75	C9	F4-4	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295945	76	C9	F4-6	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295946	77	C9	F5-1	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295947	78	C9	F5-3	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295948	79	C9	F5-4	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295949	80	C9	F5-6	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295950	81	C9	G3-1	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295951	82	C9	G3-3	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295952	83	C9	G3-4	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295953	84	C9	G3-6	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295954	85	C9	G4-1	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295955	86	C9	G4-3	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295956	87	C9	G4-4	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10002	A180017-03	295957	88	C9	G4-6	ND													CDM Smith	T. Miller	3/21/2018		x-NR
WH-10004	A180017-05	295958	1	B10	H2-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	295959	2	B10	G2-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	295960	3	B10	G2-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	295961	4	B10	F2-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	295962	5	B10	F2-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	295963	6	B10	E2-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	295964	7	B10	E2-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	295965	8	B10	C2-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	295966	9	B10	C2-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	295967	10	B10	K3-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	295968	11	B10	K3-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	295969	12	B10	H3-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	295970	13	B10	H3-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	295971	14	B10	G3-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	295972	15	B10	G3-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	295973	16	B10	F3-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	295974	17	B10	F3-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	295975	18	B10	E3-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	295976	19	B10	E3-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	295977	20	B10	C3-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	295978	21	B10	C3-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	295979	22	B10	B3-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	295980	23	B10	B3-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	295981	24	B10	K4-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	295982	25	B10	H4-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	295983	26	B10	H4-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	295984	27	B10	G4-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	295985	28	B10	G4-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	295986	29	B10	F4-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	295987	30	B10	F4-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	295988	31	B10	E4-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	295989	32	B10	E4-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	295990	33	B10	C4-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	295991	34	B10	C4-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	295992	35	B10	B4-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	295993	36	B10	B4-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	295994	37	B10	H5-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	295995	38	B10	H5-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	295996	39	B10	G5-6	ND													CDM Smith	T. Miller	3/21/2018		

ATTACHMENT 2
DATA SUMMARY OF STRUCTURE INFORMATION
Libby Asbestos Superfund Site - Operable Unit 3
2018 Winter Hooking/Skidding ABS

Sample Number	Lab Sample ID	Structure ID	Row Index	Grid	Grid Opening	Structure Type	Primary	Total	Length (µm)	Width (µm)	Aspect Ratio	Mineral Class	Mineral Description	Structure Identification	Sketch	Photo	EDS	Structure Comment	Verifier's Company	Verifier's Name	Date Verified	Verification Comment	DVC - 5%
WH-10004	A180017-05	295997	40	B10	G5-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	295998	41	B10	F5-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	295999	42	B10	F5-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	296000	43	A11	H2-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	296001	44	A11	G2-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	296002	45	A11	G2-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	296003	46	A11	F2-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	296004	47	A11	F2-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	296005	48	A11	E2-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	296006	49	A11	E2-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	296007	50	A11	C2-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	296008	51	A11	C2-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	296009	52	A11	K3-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	296010	53	A11	H3-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	296011	54	A11	H3-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	296012	55	A11	G3-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	296013	56	A11	G3-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	296014	57	A11	F3-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	296015	58	A11	F3-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	296016	59	A11	E3-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	296017	60	A11	E3-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	296018	61	A11	C3-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	296019	62	A11	C3-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	296020	63	A11	B3-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	296021	64	A11	K4-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	296022	65	A11	H4-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	296023	66	A11	H4-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	296024	67	A11	G4-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	296025	68	A11	G4-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	296026	69	A11	F4-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	296027	70	A11	F4-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	296028	71	A11	E4-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	296029	72	A11	E4-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	296030	73	A11	C4-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	296031	74	A11	C4-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	296032	75	A11	B4-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	296033	76	A11	B4-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	296034	77	A11	A4-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	296035	78	A11	H5-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	296036	79	A11	G5-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	296037	80	A11	G5-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	296038	81	A11	F5-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10004	A180017-05	296039	82	A11	F5-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296040	1	C11	G2-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296041	2	C11	G2-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296042	3	C11	F2-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296043	4	C11	F2-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296044	5	C11	E2-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296045	6	C11	E2-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296046	7	C11	C2-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296047	8	C11	C2-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296048	9	C11	K3-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296049	10	C11	K3-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296050	11	C11	H3-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296051	12	C11	H3-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296052	13	C11	G3-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296053	14	C11	G3-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296054	15	C11	F3-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296055	16	C11	F3-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296056	17	C11	E3-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296057	18	C11	E3-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296058	19	C11	C3-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296059	20	C11	C3-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296060	21	C11	B3-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296061	22	C11	B3-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296062	23	C11	K4-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296063	24	C11	H4-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296064	25	C11	H4-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296065	26	C11	G4-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296066	27	C11	G4-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296067	28	C11	F4-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296068	29	C11	F4-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296069	30	C11	E4-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296070	31	C11	E4-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296071	32	C11	C4-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296072	33	C11	C4-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296073	34	C11	B4-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296074	35	C11	B4-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296075	36	C11	H5-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296076	37	C11	G5-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296077	38	C11	G5-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296078	39	C11	F5-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296079	40	C11	F5-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296080	41	C11	E5-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296081	42	C11	E5-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296082	43	A12	G2-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296083	44	A12	F2-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296084	45	A12	F2-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296085	46	A12	E2-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296086	47	A12	E2-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296087	48	A12	C2-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296088	49	A12	C2-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296089	50	A12	B2-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296090	51	A12	H3-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296091	52	A12	H3-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296092	53	A12	G3-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296093	54	A12	G3-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296094	55	A12	F3-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296095	56	A12	F3-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296096	57	A12	E3-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296097	58	A12	E3-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296098	59	A12	C3-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296099	60	A12	C3-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296100	61	A12	B3-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296101	62	A12	B3-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296102	63	A12	A3-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296103	64	A12	H4-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296104	65	A12	H4-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296105	66	A12	G4-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296106	67	A12	G4-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296107	68	A12	F4-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296108	69	A12	F4-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296109	70	A12	E4-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296110	71	A12	E4-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296111	72	A12	C4-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296112	73	A12	C4-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296113	74	A12	B4-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296114	75	A12	B4-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296115	76	A12	A4-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296116	77	A12	H5-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296117	78	A12	H5-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296118	79	A12	G5-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296119	80	A12	G5-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296120	81	A12	F5-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10006	A180017-07	296121	82	A12	F5-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296122	1	A13	H2-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296123	2	A13	H2-3	ND													CDM Smith	T. Miller	3/21/2018		

ATTACHMENT 2
DATA SUMMARY OF STRUCTURE INFORMATION
Libby Asbestos Superfund Site - Operable Unit 3
2018 Winter Hooking/Skidding ABS

Sample Number	Lab Sample ID	Structure ID	Row Index	Grid	Grid Opening	Structure Type	Primary	Total	Length (µm)	Width (µm)	Aspect Ratio	Mineral Class	Mineral Description	Structure Identification	Sketch	Photo	EDS	Structure Comment	Verifier's Company	Verifier's Name	Date Verified	Verification Comment	DVC - 5%
WH-10008	A180017-09	296124	3	A13	G2-6	F	1	1	5.2	0.6	8.6666667	LA		ADX	1	1	1	NaK, WRTA	CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296125	4	A13	G2-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296126	5	A13	F2-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296127	6	A13	F2-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296128	7	A13	E2-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296129	8	A13	E2-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296130	9	A13	C2-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296131	10	A13	C2-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296132	11	A13	K3-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296133	12	A13	K3-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296134	13	A13	H3-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296135	14	A13	H3-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296136	15	A13	G3-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296137	16	A13	G3-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296138	17	A13	F3-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296139	18	A13	F3-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296140	19	A13	E3-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296141	20	A13	E3-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296142	21	A13	C3-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296143	22	A13	C3-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296144	23	A13	B3-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296145	24	A13	B3-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296146	25	A13	K4-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296147	26	A13	K4-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296148	27	A13	H4-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296149	28	A13	H4-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296150	29	A13	G4-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296151	30	A13	G4-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296152	31	A13	F4-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296153	32	A13	F4-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296154	33	A13	E4-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296155	34	A13	E4-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296156	35	A13	K5-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296157	36	A13	H5-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296158	37	A13	H5-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296159	38	A13	G5-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296160	39	A13	G5-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296161	40	A13	F5-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296162	41	B13	G2-4	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296163	42	B13	G2-1	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296164	43	B13	F2-4	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296165	44	B13	F2-1	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296166	45	B13	E2-4	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296167	46	B13	E2-1	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296168	47	B13	C2-4	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296169	48	B13	K3-1	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296170	49	B13	H3-4	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296171	50	B13	H3-1	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296172	51	B13	G3-4	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296173	52	B13	G3-1	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296174	53	B13	F3-4	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296175	54	B13	F3-1	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296176	55	B13	E3-4	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296177	56	B13	E3-1	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296178	57	B13	C3-4	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296179	58	B13	C3-1	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296180	59	B13	B3-4	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296181	60	B13	B3-1	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296182	61	B13	K4-1	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296183	62	B13	H4-4	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296184	63	B13	H4-1	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296185	64	B13	G4-4	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296186	65	B13	G4-1	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296187	66	B13	F4-4	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296188	67	B13	F4-1	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296189	68	B13	E4-4	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296190	69	B13	E4-1	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296191	70	B13	C4-4	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296192	71	B13	C4-1	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296193	72	B13	B4-4	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296194	73	B13	B4-1	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296195	74	B13	A4-4	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296196	75	B13	H5-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296197	76	B13	H5-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296198	77	B13	G5-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296199	78	B13	G5-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296200	79	B13	F5-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296201	80	B13	F5-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296202	81	B13	E5-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10008	A180017-09	296203	82	B13	E5-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296204	1	A14	C4-1	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296205	2	A14	C4-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296206	3	A14	C4-4	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296207	4	A14	C4-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296208	5	A14	E3-1	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296209	6	A14	E3-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296210	7	A14	E3-4	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296211	8	A14	E3-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296212	9	A14	E4-1	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296213	10	A14	E4-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296214	11	A14	E4-4	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296215	12	A14	E4-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296216	13	A14	E5-1	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296217	14	A14	E5-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296218	15	A14	E5-4	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296219	16	A14	E5-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296220	17	A14	F3-1	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296221	18	A14	F3-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296222	19	A14	F3-4	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296223	20	A14	F3-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296224	21	A14	F4-1	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296225	22	A14	F4-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296226	23	A14	F4-4	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296227	24	A14	F4-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296228	25	A14	F5-1	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296229	26	A14	F5-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296230	27	A14	F5-4	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296231	28	A14	F5-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296232	29	A14	G3-1	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296233	30	A14	G3-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296234	31	A14	G3-4	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296235	32	A14	G3-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296236	33	A14	G4-1	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296237	34	A14	G4-3	F	0	0	7.5	1.8	4.1666667	NAM		NAM	1		1	; High Al	CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296238	35	A14	G4-4	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296239	36	A14	G4-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296240	37	A14	G5-1	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296241	38	A14	G5-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296242	39	A14	G5-4	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296243	40	A14	G5-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296244	41	A14	H4-1	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296245	42	A14	H4-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296246	43	A14	H4-4	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296247	44	A14	H4-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296248	45	B14	C3-1	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296249	46	B14	C3-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296250	47	B14	C3-4	ND													CDM Smith	T. Miller	3/21/2018		

ATTACHMENT 2
DATA SUMMARY OF STRUCTURE INFORMATION
Libby Asbestos Superfund Site - Operable Unit 3
2018 Winter Hooking/Skidding ABS

Sample Number	Lab Sample ID	Structure ID	Row Index	Grid	Grid Opening	Structure Type	Primary	Total	Length (µm)	Width (µm)	Aspect Ratio	Mineral Class	Mineral Description	Structure Identification	Sketch	Photo	EDS	Structure Comment	Verifier's Company	Verifier's Name	Date Verified	Verification Comment	DVC - 5%
WH-10010	A180017-11	296251	48	B14	C3-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296252	49	B14	C4-1	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296253	50	B14	C4-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296254	51	B14	C4-4	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296255	52	B14	C4-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296256	53	B14	C5-1	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296257	54	B14	C5-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296258	55	B14	C5-4	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296259	56	B14	C5-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296260	57	B14	E3-1	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296261	58	B14	E3-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296262	59	B14	E3-4	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296263	60	B14	E3-6	F	1	1	8.2	1.2	6.8333333	LA		ADX	1	1	1	NaK, WRTA; XGBLD	CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296264	61	B14	E4-1	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296265	62	B14	E4-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296266	63	B14	E4-4	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296267	64	B14	E4-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296268	65	B14	E5-1	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296269	66	B14	E5-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296270	67	B14	E5-4	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296271	68	B14	E5-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296272	69	B14	F3-1	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296273	70	B14	F3-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296274	71	B14	F3-4	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296275	72	B14	F3-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296276	73	B14	F4-1	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296277	74	B14	F4-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296278	75	B14	F4-4	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296279	76	B14	F4-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296280	77	B14	F5-1	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296281	78	B14	F5-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296282	79	B14	F5-4	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296283	80	B14	F5-6	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296284	81	B14	G5-1	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296285	82	B14	G5-3	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296286	83	B14	G5-4	ND													CDM Smith	T. Miller	3/21/2018		
WH-10010	A180017-11	296287	84	B14	G5-6	ND													CDM Smith	T. Miller	3/21/2018		

Notes:
µm = micrometer
ABS = activity-based sampling
DVC = Data Verification Coordinator
EDS = energy dispersive spectroscopy
ID = identification
LA = Libby amphibole asbestos
NAM = non-asbestos material
OA = other amphibole

Attachment 3

Laboratory Documentation

TLF-12.01
Effective Date: 07/03/2014

TEM Asbestos Structure Count Bench Sheet

Laboratory Name	ESATR8
Site or Project Name	Libby 08BC [OU3]
Client	USEPA Region 8
Chain of Custody Number	021318CL01
Lab Job Number	A180017
Lab Sample ID	A180017-03
Client Sample Number	WH-10002
Tag	AL1
Lab Receipt Date	02/15/2018
Analysis Method	TEM-ISO
Sample Matrix	Air
Sample Type (field, blank, etc.)	Field Sample
QC Type	Not QC
Analysis Status	Analyzed
Prepared By	D. Kent
Preparation Date	02/16/2018
Volume (L) or Area (cm²)	120
Lab Comments	
Grid Prep Acceptable? Y or N (explain)	Y

Circle Prep Type: Direct Indirect Indirect-Ashed	Direct
Loose Material in cowl?	Y N — N
Est. Filter Particulate Loading (%)	4
Instrument	JEOL JEM-1011 (C24)
Voltage (kV)	100
Magnification (X)	5,000
Primary Filter Area (mm²)	385
Primary Filter Pore Size (µm)	0.8
Sec Filter Area (mm²)	-
Sec Filter Pore Size (µm)	-
Grid Opening Area (mm²)	0.0103
Number of Grids Prepared	3
Archive Filter(s) Location	ESATR8
Grid Storage Location	ESATR8
Grid Box	B8
Grid Slots	B9, C9, A10
Filter Type	MCE

Minimum Aspect Ratio	3:1
Minimum Length (µm)	> 5
Minimum Width (µm)	0.25
Max # Structures	25
Max # Grid Openings	331
Target Analytical Sensitivity (s/cc)	0.0038
# of GO's to Reach Target AS	82
GO Traverse Direction (V or H)	H
GO Orientation (Sketch letter F)	F, F

F-Factor Calculation (if applicable)

Indirect Fraction Primary Filter	-
Analysis Aliquot 1 (mL)	-
Analysis Volume 1 (ml)	-
Indirect Fraction Secondary Filter	-
Analysis Aliquot 2 (mL)	-
Analysis Volume 2 (mL)	-
Analysis Aliquot 3 (mL)	-
Analysis Volume 3 (mL)	-
F-Factor	1

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GO #	Grid	Grid Opening	Structure Type (ND, F, B, CD, CB, CF, MD, etc.)	Number of Structures: Primary	Number of Structures: Total	Structure Dimensions (µm): Length	Structure Dimensions (µm): Width	ID Method (ADX, CD, NAM, etc.)	Mineral Class: LA	Mineral Class: OA	Mineral Class: CH	Mineral Class: NAM	Sketch/ Comments	Mineral ID (WRTA, AC, TR, AT, AM, AN, CH, CR, PY, OT, UN)	EDXA Observation (NaK, NaX, XK, XX, NA)	Photo	EDXA (spectrum saved)	Check if GO not analyzed for Chrysotile
	B9	C3-1	ND															
	↓	C3-3	↓															
		C3-4																
		C3-6																
		C4-1																

0/5 Analyst: D. Kent

√ MN 5/20 DVC

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Date: 2/22/18

√DM

TLF-12.01
Effective Date: 07/03/2014

TEM Asbestos Structure Count Bench Sheet

QC Type: Not QC

Lab Job Number: A180017

Client Sample Number: WH-10002

Lab Sample ID: A180017-03

GO #	Grid	Grid Opening	Structure Type (ND, F, B, CD, CB, CF, MD, etc.)	Number of Structures: Primary	Number of Structures: Total	Structure Dimensions (µm): Length	Structure Dimensions (µm): Width	ID Method (ADX, CD, NAM, etc.)	Mineral Class (check one): LA	OA	CH	NAM	Sketch/ Comments	Mineral ID (WRTA, AC, TR, AT, AM, AN, CH, CR, PY, OT, UN)	EDXA Observation (NaK, NaX, XK, XX, NA)	Record number of spectrum or photo if taken: Photo	EDXA (spectrum saved)	Check if GO not analyzed for Chrysotile
	B9	C4-3	ND															
		C4-4																
		C4-6																
		C5-1																
		C5-3																
		C5-4																
12		C5-6																
		E3-1																
		E3-3																
		E3-4																
		E3-6																
		E4-1																
		E4-3																
		E4-4																
		E4-6																

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Analyst: D. Kent

Date: 02/22/18

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TLF-12.01
Effective Date: 07/03/2014

TEM Asbestos Structure Count Bench Sheet

QC Type: Not QC   Page 3 of 7

Lab Job Number: A180017   Client Sample Number: WH-10002   Lab Sample ID: A180017-03

GO #	Grid	Grid Opening	Structure Type (ND, F, B, CD, CB, CF, MD, etc.)	Number of Structures		Structure Dimensions (µm)		ID Method (ADX, CD, NAM, etc.)	Mineral Class (check one)				Sketch/ Comments	Mineral ID (WRTA, AC, TR, AT, AM, AN, CH, CR, PY, OT, UN)	EDXA Observation (NaK, NaX, XK, XX, NA)	Record number of spectrum or photo if taken		Check if GO not analyzed for Chrysotile
				Primary	Total	Length	Width		LA	OA	CH	NAM				Photo	EDXA (spectrum saved)	
	B9	E5-1	ND															
		E5-3																
		E5-4																
		E5-6																
		F3-1																
		F3-3																
		F3-4																
		F3-6																
		F4-1																
		F4-3																
		F4-4																
32		F4-6																
		F5-1																
		F5-3																
		F5-4																

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Analyst: D. Kent   Date: 02/22/18

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TLF-12.01
Effective Date: 07/03/2014

TEM Asbestos Structure Count Bench Sheet

QC Type: Not QC

Lab Job Number: A180017 Client Sample Number: WH-10002 ✓ Lab Sample ID: A180017-03

GO #	Grid	Grid Opening	Structure Type (ND, F, B, CD, CB, CF, MD, etc.)	Number of Structures		Structure Dimensions (µm)		ID Method (ADX, CD, NAM, etc.)	Mineral Class (check one)				Sketch/ Comments	Mineral ID (WRTA, AC, TR, AT, AM, AN, CH, CR, PY, OT, UN)	EDXA Observation (NaK, NaX, XK, XX, NA)	Record number of spectrum or photo if taken		Check if GO not analyzed for Chrysotile
				Primary	Total	Length	Width		LA	OA	CH	NAM				Photo	EDXA (spectrum saved)	
36	B9	F5-6	ND															
		G3-1																
		G3-3																
		G3-4																
		G3-6																
		G4-1																
		G4-3																
		G4-4																
✓44		G4-6																
	✓C9	C3-1																
		C3-3																
		C3-4																
		C3-6																
	DK 2/22/18	C4-1																
		C4-3																

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Analyst: D. Kent Date: 02/22/18

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DM

TEM Asbestos Structure Count Bench Sheet

QC Type: Not QC

Lab Job Number: A180017

Client Sample Number: WH-10002 ✓

Lab Sample ID: A180017-03

GO #	Grid	Grid Opening	Structure Type (ND, F, B, CD, CB, CF, MD, etc.)	Number of Structures		Structure Dimensions (µm)		ID Method (ADX, CD, NAM, etc.)	Mineral Class (check one)				Sketch/ Comments	Mineral ID (WRTA, AC, TR, AT, AM, AN, CH, CR, PY, OT, UN)	EDXA Observation (NaK, NaX, XK, XX, NA)	Record number of spectrum or photo if taken		Check if GO not analyzed for Chrysotile
				Primary	Total	Length	Width		LA	OA	CH	NAM				Photo	EDXA (spectrum saved)	
	C9	C4-4	ND															
	↓	C4-6	↓															
		C5-1																
		C5-3																
		C5-4																
		C5-6																
		E3-1																
		E3-3																
		E3-4																
		E3-6																
		E4-1																
		E4-3																
		E4-4																
		E4-6																
	↓	E5-1	↓															

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Analyst: D. Kent

Date: 02/23/18

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TDM

TEM Asbestos Structure Count Bench Sheet

QC Type: Not QC

Lab Job Number: A180017

Client Sample Number: WH-10002

Lab Sample ID: A180017-03

GO #	Grid	Grid Opening	Structure Type (ND, F, B, CD, CB, CF, MD, etc.)	Number of Structures: Primary	Number of Structures: Total	Structure Dimensions (µm): Length	Structure Dimensions (µm): Width	ID Method (ADX, CD, NAM, etc.)	Mineral Class (check one): LA	OA	CH	NAM	Sketch/ Comments	Mineral ID (WRTA, AC, TR, AT, AM, AN, CH, CR, PY, OT, UN)	EDXA Observation (NaK, NaX, XK, XX, NA)	Record number of spectrum or photo if taken: Photo	EDXA (spectrum saved)	Check if GO not analyzed for Chrysotile
	C9	E5-3	ND															
		E5-4																
		E5-6																
		F3-1																
		F3-3																
		F3-4																
		F3-6																
		F4-1																
		F4-3																
		F4-4																
		F4-6																
		F5-1																
		F5-3																
		F5-4																
80		F5-6																

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Analyst: D. Kent

Date: 02/23/18

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TDK

TEM Asbestos Structure Count Bench Sheet

QC Type: Not QC

Lab Job Number: A180017

Client Sample Number: WH-10002 ✓

Lab Sample ID: A180017-03

GO #	Grid	Grid Opening	Structure Type (ND, F, B, CD, CB, CF, MD, etc.)	Number of Structures Primary	Number of Structures Total	Structure Dimensions (µm) Length	Structure Dimensions (µm) Width	ID Method (ADX, CD, NAM, etc.)	Mineral Class (check one) LA	OA	CH	NAM	Sketch/ Comments	Mineral ID (WRTA, AC, TR, AT, AM, AN, CH, CR, PY, OT, UN)	EDXA Observation (NaK, NaX, XK, XX, NA)	Record number of spectrum or photo if taken: Photo	EDXA (spectrum saved)	Check if GO not analyzed for Chrysotile
	C9	G3-1	ND															
		G3-3																
		G3-4																
		G3-6																
		G4-1																
		G4-3																
		G4-4																
~~88~~		G4-6																

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DK 2/23/18

Analyst: D. Kent

Date: 02/23/18

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TDM

TEM Asbestos Structure Count Bench Sheet

Laboratory Name	ESATR8
Site or Project Name	Libby 08BC [OU3]
Client	USEPA Region 8
Chain of Custody Number	021318CL01
Lab Job Number	A180017
Lab Sample ID	A180017-05
Client Sample Number	WH-10004
Tag	AL1
Lab Receipt Date	02/15/2018
Analysis Method	TEM-ISO
Sample Matrix	Air
Sample Type (field, blank, etc.)	Field Sample
QC Type	Not QC
Analysis Status	Analyzed
Prepared By	D. Kent
Preparation Date	02/16/2018
Volume (L) or Area (cm²)	120
Lab Comments	
Grid Prep Acceptable? Y or N (explain)	

Circle Prep Type: Direct Indirect Indirect-Ashed	Direct
Loose Material in cowl?	Y N — N
Est. Filter Particulate Loading (%)	3
Instrument	JEOL JEM-1011 (C24)
Voltage (kV)	100
Magnification (X)	5,000
Primary Filter Area (mm²)	385
Primary Filter Pore Size (µm)	0.8
Sec Filter Area (mm²)	-
Sec Filter Pore Size (µm)	-
Grid Opening Area (mm²)	0.0103
Number of Grids Prepared	3
Archive Filter(s) Location	ESATR8
Grid Storage Location	ESATR8
Grid Box	B8
Grid Slots	B10, A11, B11
Filter Type	MCE

Minimum Aspect Ratio	3:1
Minimum Length (µm)	> 5
Minimum Width (µm)	0.25
Max # Structures	25
Max # Grid Openings	331
Target Analytical Sensitivity (s/cc)	0.0038
# of GO's to Reach Target AS	82
GO Traverse Direction (V or H)	H
GO Orientation (Sketch letter F)	F, F

F-Factor Calculation (if applicable)

Indirect Fraction Primary Filter	-
Analysis Aliquot 1 (mL)	-
Analysis Volume 1 (ml)	-
Indirect Fraction Secondary Filter	-
Analysis Aliquot 2 (mL)	-
Analysis Volume 2 (mL)	-
Analysis Aliquot 3 (mL)	-
Analysis Volume 3 (mL)	-
F-Factor	1

GO #	Grid	Grid Opening	Structure Type (ND, F, B, CD, CB, CF, MD, etc.)	Number of Structures: Primary	Number of Structures: Total	Structure Dimensions (µm): Length	Structure Dimensions (µm): Width	ID Method (ADX, CD, NAM, etc.)	Mineral Class (check one): LA	OA	CH	NAM	Sketch/ Comments	Mineral ID (WRTA, AC, TR, AT, AM, AN, CH, CR, PY, OT, UN)	EDXA Observation (NaK, NaX, XK, XX, NA)	Record number of spectrum or photo if taken: Photo	EDXA (spectrum saved)	Check if GO not analyzed for Chrysotile
1	B10	H2-3	ND															
		G2-6																
		G2-3																
		F2-6																
		F2-3																

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Analyst: N. Dellhierro

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Date: 2/23/18

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TLF-12.01
Effective Date: 07/03/2014

TEM Asbestos Structure Count Bench Sheet

QC Type: Not QC

Lab Job Number: A180017

Client Sample Number: WH-10004 ✓

Lab Sample ID: A180017-05

GO #	Grid	Grid Opening	Structure Type (ND, F, B, CD, CB, CF, MD, etc.)	Number of Structures		Structure Dimensions (µm)		ID Method (ADX, CD, NAM, etc.)	Mineral Class (check one)				Sketch/ Comments	Mineral ID (WRTA, AC, TR, AT, AM, AN, CH, CR, PY, OT, UN)	EDXA Observation (NaK, NaX, XK, XX, NA)	Record number of spectrum or photo if taken		Check if GO not analyzed for Chrysotile
				Primary	Total	Length	Width		LA	OA	CH	NAM				Photo	EDXA (spectrum saved)	
	B10	E2-6	ND															
		E2-3																
		C2-6																
		C2-3																
		K3-6																
		K3-3																
		H3-6																
		H3-3																
		G3-6																
		G3-3																
		F3-6																
		F3-3																
		E3-6																
		E3-3																
		C3-6																

Analyst: N. DelHierro

Date: 2/23/18

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TEM Asbestos Structure Count Bench Sheet

QC Type: Not QC

Lab Job Number: A180017

Client Sample Number: WH-10004 ✓

Lab Sample ID: A180017-05

GO #	Grid	Grid Opening	Structure Type (ND, F, B, CD, CB, CF, MD, etc.)	Number of Structures		Structure Dimensions (µm)		ID Method (ADX, CD, NAM, etc.)	Mineral Class (check one)				Sketch/ Comments	Mineral ID (WRTA, AC, TR, AT, AM, AN, CH, CR, PY, OT, UN)	EDXA Observation (NaK, NaX, XK, XX, NA)	Record number of spectrum or photo if taken		Check if GO not analyzed for Chrysotile
				Primary	Total	Length	Width		LA	OA	CH	NAM				Photo	EDXA (spectrum saved)	
	B10	C3-3	ND															
		B3-6																
		B3-3																
		K4-3																
		H4-6																
		H4-3																
		G4-6																
		G4-3																
		F4-6																
		F4-3																
		E4-6																
		E4-3																
		C4-6																
		C4-3																
		B4-6																

Analyst: N. DelHierro

Date: 2/23/18

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TEM Asbestos Structure Count Bench Sheet

QC Type: Not QC

Lab Job Number: A180017

Client Sample Number: WH-10004 ✓

Lab Sample ID: A180017-05

GO #	Grid	Grid Opening	Structure Type (ND, F, B, CD, CB, CF, MD, etc.)	Number of Structures		Structure Dimensions (µm)		ID Method (ADX, CD, NAM, etc.)	Mineral Class (check one)				Sketch/ Comments	Mineral ID (WRTA, AC, TR, AT, AM, AN, CH, CR, PY, OT, UN)	EDXA Observation (NaK, NaX, XK, XX, NA)	Record number of spectrum or photo if taken		Check if GO not analyzed for Chrysotile
				Primary	Total	Length	Width		LA	OA	CH	NAM				Photo	EDXA (spectrum saved)	
	B10	B4-3	ND															
		H5-6																
		H5-3																
		G5-6																
		G5-3																
		F5-6																
		F5-3																
	A11	H2-3																
		G2-6																
		G2-3																
		F2-6																
		F2-3																
		E2-6																
		E2-3																
		C2-6																

Analyst: N. DelHierro

Date: 2/23/18

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TDT

TEM Asbestos Structure Count Bench Sheet

QC Type: Not QC

Lab Job Number: A180017

Client Sample Number: WH-10004 ✓

Lab Sample ID: A180017-05

GO #	Grid	Grid Opening	Structure Type (ND, F, B, CD, CB, CF, MD, etc.)	Number of Structures		Structure Dimensions (µm)		ID Method (ADX, CD, NAM, etc.)	Mineral Class (check one)				Sketch/ Comments	Mineral ID (WRTA, AC, TR, AT, AM, AN, CH, CR, PY, OT, UN)	EDXA Observation (NaK, NaX, XK, XX, NA)	Record number of spectrum or photo if taken		Check if GO not analyzed for Chrysotile
				Primary	Total	Length	Width		LA	OA	CH	NAM				Photo	EDXA (spectrum saved)	
	All	C2-3	ND															
		K3-3																
		H3-6																
		H3-3																
		G3-6																
		G3-3																
		F3-6																
		F3-3																
		E3-6																
		E3-3																
		C3-6																
		C3-3																
		B3-6																
		K4-3																
		H4-6																

Analyst: N. DelHierro

Date: 2/23/18

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TEM Asbestos Structure Count Bench Sheet

QC Type: Not QC

Lab Job Number: A180017

Client Sample Number: WH-10004 ✓

Lab Sample ID: A180017-05

GO #	Grid	Grid Opening	Structure Type (ND, F, B, CD, CB, CF, MD, etc.)	Number of Structures		Structure Dimensions (µm)		ID Method (ADX, CD, NAM, etc.)	Mineral Class (check one)				Sketch/ Comments	Mineral ID (WRTA, AC, TR, AT, AM, AN, CH, CR, PY, OT, UN)	EDXA Observation (NaK, NaX, XK, XX, NA)	Record number of spectrum or photo if taken		Check if GO not analyzed for Chrysotile
				Primary	Total	Length	Width		LA	OA	CH	NAM				Photo	EDXA (spectrum saved)	
	All	H4-3	ND															
		G4-6																
		G4-3																
		F4-6																
		F4-3																
		E4-6																
		E4-3																
		C4-6																
		C4-3																
		B4-6																
		B4-3																
		A4-6																
		H5-3																
		G5-6																
		G5-3																

Analyst: N. DelHierro

Date: 2/23/18

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TLF-12.01
Effective Date: 07/03/2014

TEM Asbestos Structure Count Bench Sheet

QC Type: Not QC

Lab Job Number: A180017 Client Sample Number: WH-10004 ✓ Lab Sample ID: A180017-05

GO #	Grid	Grid Opening	Structure Type (ND, F, B, CD, CB, CF, MD, etc.)	Number of Structures		Structure Dimensions (µm)		ID Method (ADX, CD, NAM, etc.)	Mineral Class (check one)				Sketch/ Comments	Mineral ID (WRTA, AC, TR, AT, AM, AN, CH, CR, PY, OT, UN)	EDXA Observation (NaK, NaX, XK, XX, NA)	Record number of spectrum or photo if taken		Check if GO not analyzed for Chrysotile
				Primary	Total	Length	Width		LA	OA	CH	NAM				Photo	EDXA (spectrum saved)	
	All	FS-6	ND															
82	↓	FS-3	↓															

Analyst: N. DelHierro Date: 2/23/18

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TDM

TEM Asbestos Structure Count Bench Sheet

Laboratory Name	ESATR8
Site or Project Name	Libby 08BC [OU3]
Client	USEPA Region 8
Chain of Custody Number	021318CL01
Lab Job Number	A180017
Lab Sample ID	A180017-07
Client Sample Number	WH-10006
Tag	AL1
Lab Receipt Date	02/15/2018
Analysis Method	TEM-ISO
Sample Matrix	Air
Sample Type (field, blank, etc.)	Field Sample
QC Type	Not QC
Analysis Status	Analyzed
Prepared By	D. Kent
Preparation Date	02/16/2018
Volume (L) or Area (cm²)	120
Lab Comments	
Grid Prep Acceptable? Y or N (explain)	

Circle Prep Type: Direct Indirect Indirect-Ashed	Direct
Loose Material in cowl?	Y N — N
Est. Filter Particulate Loading (%)	3
Instrument	JEOL JEM-1011 (C24)
Voltage (kV)	100
Magnification (X)	5,000
Primary Filter Area (mm²)	385
Primary Filter Pore Size (µm)	0.8
Sec Filter Area (mm²)	-
Sec Filter Pore Size (µm)	-
Grid Opening Area (mm²)	0.0103
Number of Grids Prepared	3
Archive Filter(s) Location	ESATR8
Grid Storage Location	ESATR8
Grid Box	B8
Grid Slots	C11, A12, B12
Filter Type	MCE

Minimum Aspect Ratio	3:1
Minimum Length (µm)	> 5
Minimum Width (µm)	0.25
Max # Structures	25
Max # Grid Openings	331
Target Analytical Sensitivity (s/cc)	0.0038
# of GO's to Reach Target AS	82
GO Traverse Direction (V or H)	H
GO Orientation (Sketch letter F)	F, F
F-Factor Calculation (if applicable)	
Indirect Fraction Primary Filter	-
Analysis Aliquot 1 (mL)	-
Analysis Volume 1 (ml)	-
Indirect Fraction Secondary Filter	-
Analysis Aliquot 2 (mL)	-
Analysis Volume 2 (mL)	-
Analysis Aliquot 3 (mL)	-
Analysis Volume 3 (mL)	-
F-Factor	1

GO #	Grid	Grid Opening	Structure Type (ND, F, B, CD, CB, CF, MD, etc.)	Number of Structures: Primary	Number of Structures: Total	Structure Dimensions (µm): Length	Structure Dimensions (µm): Width	ID Method (ADX, CD, NAM, etc.)	Mineral Class: LA	Mineral Class: OA	Mineral Class: CH	Mineral Class: NAM	Sketch/ Comments	Mineral ID (WRTA, AC, TR, AT, AM, AN, CH, CR, PY, OT, UN)	EDXA Observation (NaK, NaX, XK, XX, NA)	Photo	EDXA (spectrum saved)	Check if GO not analyzed for Chrysotile
1	C11	G2-6	ND															
		G2-3																
		F2-6																
		F2-3																
		E2-6																

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Analyst: N. DelHierro

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Date: 2/23/18

TDM

TEM Asbestos Structure Count Bench Sheet

QC Type: Not QC

Lab Job Number: A180017

Client Sample Number: WH-10006 ✓

Lab Sample ID: A180017-07

GO #	Grid	Grid Opening	Structure Type (ND, F, B, CD, CB, CF, MD, etc.)	Number of Structures		Structure Dimensions (µm)		ID Method (ADX, CD, NAM, etc.)	Mineral Class (check one)				Sketch/ Comments	Mineral ID (WRTA, AC, TR, AT, AM, AN, CH, CR, PY, OT, UN)	EDXA Observation (NaK, NaX, XK, XX, NA)	Record number of spectrum or photo if taken		Check if GO not analyzed for Chrysotile
				Primary	Total	Length	Width		LA	OA	CH	NAM				Photo	EDXA (spectrum saved)	
	C11	E2-3	ND															
		C2-6																
		C2-3																
		K3-6																
		K3-3																
		H3-6																
		H3-3																
		G3-6																
		G3-3																
		F3-6																
		F3-3																
		E3-6																
		E3-3																
		C3-6																
		C3-3																

Analyst: N. DelHierro

Date: 2/23/18

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TEM Asbestos Structure Count Bench Sheet

QC Type: Not QC

Lab Job Number: A180017

Client Sample Number: WH-10006 ✓

Lab Sample ID: A180017-07

GO #	Grid	Grid Opening	Structure Type (ND, F, B, CD, CB, CF, MD, etc.)	Number of Structures		Structure Dimensions (µm)		ID Method (ADX, CD, NAM, etc.)	Mineral Class (check one)				Sketch/ Comments	Mineral ID (WRTA, AC, TR, AT, AM, AN, CH, CR, PY, OT, UN)	EDXA Observation (NaK, NaX, XK, XX, NA)	Record number of spectrum or photo if taken		Check if GO not analyzed for Chrysotile
				Primary	Total	Length	Width		LA	OA	CH	NAM				Photo	EDXA (spectrum saved)	
	C11	B3-6	ND															
		B3-3																
		K4-3																
		H4-6																
		H4-3																
		G4-6																
		G4-3																
		F4-6																
		F4-3																
		E4-6																
		E4-3																
		C4-6																
		C4-3																
		B4-6																
		B4-3																

Analyst: N. DalHierro

Date: 2/23/18

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TEM Asbestos Structure Count Bench Sheet

QC Type: Not QC

Lab Job Number: A180017

Client Sample Number: WH-10006 ✓

Lab Sample ID: A180017-07

GO #	Grid	Grid Opening	Structure Type (ND, F, B, CD, CB, CF, MD, etc.)	Number of Structures		Structure Dimensions (µm)		ID Method (ADX, CD, NAM, etc.)	Mineral Class (check one)				Sketch/ Comments	Mineral ID (WRTA, AC, TR, AT, AM, AN, CH, CR, PY, OT, UN)	EDXA Observation (NaK, NaX, XK, XX, NA)	Record number of spectrum or photo if taken		Check if GO not analyzed for Chrysotile
				Primary	Total	Length	Width		LA	OA	CH	NAM				Photo	EDXA (spectrum saved)	
	C11	H5-3	ND															
		G5-6																
		G5-3																
		F5-6																
		F5-3																
		E5-6																
		E5-3																
	A12	G2-3																
		F2-6																
		F2-3																
		E2-6																
		E2-3																
		C2-6																
		C2-3																
		B2-6																

Analyst: N. DelHierro

Date: 2/23/18

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TEM Asbestos Structure Count Bench Sheet

QC Type: Not QC

Lab Job Number: A180017

Client Sample Number: WH-10006

Lab Sample ID: A180017-07

GO #	Grid	Grid Opening	Structure Type (ND, F, B, CD, CB, CF, MD, etc.)	Number of Structures: Primary	Number of Structures: Total	Structure Dimensions (µm): Length	Structure Dimensions (µm): Width	ID Method (ADX, CD, NAM, etc.)	Mineral Class (check one): LA	OA	CH	NAM	Sketch/ Comments	Mineral ID (WRTA, AC, TR, AT, AM, AN, CH, CR, PY, OT, UN)	EDXA Observation (NaK, NaX, XK, XX, NA)	Record number of spectrum or photo if taken: Photo	EDXA (spectrum saved)	Check if GO not analyzed for Chrysotile
	A12	H3-6	ND															
		H3-3																
		G3-6																
		G3-3																
		F3-6																
		F3-3																
		E3-6																
		E3-3																
		C3-6																
		C3-3																
		B3-6																
		B3-3																
		A3-6																
		H4-6																
		H4-3																

Analyst: N. DelHierro

Date: 2/23/18

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TEM Asbestos Structure Count Bench Sheet

QC Type: Not QC

Lab Job Number: A180017

Client Sample Number: WH-10006 ✓

Lab Sample ID: A180017-07

GO #	Grid	Grid Opening	Structure Type (ND, F, B, CD, CB, CF, MD, etc.)	Number of Structures		Structure Dimensions (µm)		ID Method (ADX, CD, NAM, etc.)	Mineral Class (check one)				Sketch/ Comments	Mineral ID (WRTA, AC, TR, AT, AM, AN, CH, CR, PY, OT, UN)	EDXA Observation (NaK, NaX, XK, XX, NA)	Record number of spectrum or photo if taken		Check if GO not analyzed for Chrysotile
				Primary	Total	Length	Width		LA	OA	CH	NAM				Photo	EDXA (spectrum saved)	
	A12	G4-6	ND															
		G4-3																
		F4-6																
		F4-3																
		E4-6																
		E4-3																
		C4-6																
		C4-3																
		B4-6																
		B4-3																
		A4-6																
		H5-6																
		H5-3																
		G5-6																
		G5-3																

Analyst: N. DalHierro

Date: 2/23/18

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TEM Asbestos Structure Count Bench Sheet

QC Type: Not QC

Lab Job Number: A180017

Client Sample Number: WH-10006

Lab Sample ID: A180017-07

GO #	Grid	Grid Opening	Structure Type (ND, F, B, CD, CB, CF, MD, etc.)	Number of Structures		Structure Dimensions (µm)		ID Method (ADX, CD, NAM, etc.)	Mineral Class (check one)				Sketch/ Comments	Mineral ID (WRTA, AC, TR, AT, AM, AN, CH, CR, PY, OT, UN)	EDXA Observation (NaK, NaX, XK, XX, NA)	Record number of spectrum or photo if taken		Check if GO not analyzed for Chrysotile
				Primary	Total	Length	Width		LA	OA	CH	NAM				Photo	EDXA (spectrum saved)	
	A12	FS-6	ND															
82	↓	FS-3	↓															

Analyst: N. DelHierro

Date: 2/23/18

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TDM

TEM Asbestos Structure Count Bench Sheet

Laboratory Name	ESATR8
Site or Project Name	Libby 08BC [OU3]
Client	USEPA Region 8
Chain of Custody Number	021318CL01
Lab Job Number	A180017
Lab Sample ID	A180017-09
Client Sample Number	WH-10008
Tag	AL1
Lab Receipt Date	02/15/2018
Analysis Method	TEM-ISO
Sample Matrix	Air
Sample Type (field, blank, etc.)	Field Sample
QC Type	Not QC
Analysis Status	Analyzed
Prepared By	D. Kent
Preparation Date	02/16/2018
Volume (L) or Area (cm²)	120
Lab Comments	
Grid Prep Acceptable? Y or N (explain)	Y

Circle Prep Type: Direct Indirect Indirect-Ashed	Direct
Loose Material in cowl?	Y N — N
Est. Filter Particulate Loading (%)	3
Instrument	JEOL JEM-1011 (C24)
Voltage (kV)	100
Magnification (X)	5,000
Primary Filter Area (mm²)	385
Primary Filter Pore Size (µm)	0.8
Sec Filter Area (mm²)	-
Sec Filter Pore Size (µm)	-
Grid Opening Area (mm²)	0.0103
Number of Grids Prepared	3
Archive Filter(s) Location	ESATR8
Grid Storage Location	ESATR8
Grid Box	B8
Grid Slots	A13, B13, C13
Filter Type	MCE

Minimum Aspect Ratio	3:1
Minimum Length (µm)	> 5
Minimum Width (µm)	0.25
Max # Structures	25
Max # Grid Openings	331
Target Analytical Sensitivity (s/cc)	0.0038
# of GO's to Reach Target AS	82
GO Traverse Direction (V or H)	H
GO Orientation (Sketch letter F)	F, F

F-Factor Calculation (if applicable)

Indirect Fraction Primary Filter	-
Analysis Aliquot 1 (mL)	-
Analysis Volume 1 (ml)	-
Indirect Fraction Secondary Filter	-
Analysis Aliquot 2 (mL)	-
Analysis Volume 2 (mL)	-
Analysis Aliquot 3 (mL)	-
Analysis Volume 3 (mL)	-
F-Factor	1

GO #	Grid	Grid Opening	Structure Type (ND, F, B, CD, CB, CF, MD, etc.)	Number of Structures		Structure Dimensions (µm)		ID Method (ADX, CD, NAM, etc.)	Mineral Class (check one)				Sketch/ Comments	Mineral ID (WRTA, AC, TR, AT, AM, AN, CH, CR, PY, OT, UN)	EDXA Observation (NaK, NaX, XK, XX, NA)	Record number of spectrum or photo if taken		Check if GO not analyzed for Chrysotile
				Primary	Total	Length	Width		LA	OA	CH	NAM				Photo	EDXA (spectrum saved)	
1	A13	H2-6	ND															
	↓	H2-3	↓															
		G2-6	F	1	1	5.2	0.6	ADX	✓					WRTA	NaK	0641	1-WRTA	
		G2-3	ND															
		F2-6	↓															

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Analyst: N. DalHierro

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Date: 2/26/18

TDM

TLF-12.01
Effective Date: 07/03/2014

TEM Asbestos Structure Count Bench Sheet

QC Type: Not QC

Lab Job Number: A180017 Client Sample Number: WH-10008 Lab Sample ID: A180017-09

GO #	Grid	Grid Opening	Structure Type (ND, F, B, CD, CB, CF, MD, etc.)	Number of Structures: Primary	Number of Structures: Total	Structure Dimensions (µm): Length	Structure Dimensions (µm): Width	ID Method (ADX, CD, NAM, etc.)	Mineral Class (check one): LA	OA	CH	NAM	Sketch/ Comments	Mineral ID (WRTA, AC, TR, AT, AM, AN, CH, CR, PY, OT, UN)	EDXA Observation (NaK, NaX, XK, XX, NA)	Record number of spectrum or photo if taken: Photo	EDXA (spectrum saved)	Check if GO not analyzed for Chrysotile
	A13	F2-3	ND															
		E2-6																
		E2-3																
		C2-6																
		C2-3																
		K3-6																
		K3-3																
		H3-6																
		H3-3																
		G3-6																
		G3-3																
		F3-6																
		F3-3																
		E3-6																
		E3-3																

Analyst: N. DelHierro Date: 2/26/18

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TDM

TEM Asbestos Structure Count Bench Sheet

QC Type: Not QC

Lab Job Number: A180017

Client Sample Number: WH-10008

Lab Sample ID: A180017-09

GO #	Grid	Grid Opening	Structure Type (ND, F, B, CD, CB, CF, MD, etc.)	Number of Structures: Primary	Number of Structures: Total	Structure Dimensions (µm): Length	Structure Dimensions (µm): Width	ID Method (ADX, CD, NAM, etc.)	Mineral Class (check one): LA	OA	CH	NAM	Sketch/ Comments	Mineral ID (WRTA, AC, TR, AT, AM, AN, CH, CR, PY, OT, UN)	EDXA Observation (NaK, NaX, XK, XX, NA)	Record number of spectrum or photo if taken: Photo	EDXA (spectrum saved)	Check if GO not analyzed for Chrysotile
	A13	C3-6	ND															
		C3-3																
		B3-6																
		B3-3																
		K4-6																
		K4-3																
		H4-6																
		H4-3																
		G4-6																
		G4-3																
		F4-6																
		F4-3																
		E4-6																
		E4-3																
		K5-3																

Analyst: N. Del Hierro

Date: 2/26/18

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TDM

TEM Asbestos Structure Count Bench Sheet

QC Type: Not QC

Lab Job Number: A180017

Client Sample Number: WH-10008 ✓

Lab Sample ID: A180017-09

GO #	Grid	Grid Opening	Structure Type (ND, F, B, CD, CB, CF, MD, etc.)	Number of Structures		Structure Dimensions (µm)		ID Method (ADX, CD, NAM, etc.)	Mineral Class (check one)				Sketch/ Comments	Mineral ID (WRTA, AC, TR, AT, AM, AN, CH, CR, PY, OT, UN)	EDXA Observation (NaK, NaX, XK, XX, NA)	Record number of spectrum or photo if taken		Check if GO not analyzed for Chrysotile
				Primary	Total	Length	Width		LA	OA	CH	NAM				Photo	EDXA (spectrum saved)	
	A13	H5-6	ND															
	↓	H5-3	↓															
	↓	G5-6	↓															
	↓	G5-3	↓															
	↓	F5-6	↓															
	B13	G2-4	↓															
	↓	G2-1	↓															
	↓	F2-4	↓															
	↓	F2-1	↓															
	↓	E2-4	↓															
	↓	E2-1	↓															
	↓	C2-4	↓															
	↓	K3-1	↓															
	↓	H3-4	↓															
	↓	H3-1	↓															

Analyst: N. DelHierro

Date: 2/26/18

0/15

VDM

TEM Asbestos Structure Count Bench Sheet

QC Type: Not QC ✓ Page 5 of 7

Lab Job Number: A180017 Client Sample Number: WH-10008 Lab Sample ID: A180017-09

GO #	Grid	Grid Opening	Structure Type (ND, F, B, CD, CB, CF, MD, etc.)	Number of Structures		Structure Dimensions (µm)		ID Method (ADX, CD, NAM, etc.)	Mineral Class (check one)				Sketch/ Comments	Mineral ID (WRTA, AC, TR, AT, AM, AN, CH, CR, PY, OT, UN)	EDXA Observation (NaK, NaX, XK, XX, NA)	Record number of spectrum or photo if taken		Check if GO not analyzed for Chrysotile
				Primary	Total	Length	Width		LA	OA	CH	NAM				Photo	EDXA (spectrum saved)	
	B13	G3-4	ND															
		G3-1																
		F3-4																
		F3-1																
		E3-4																
		E3-1																
		C3-4																
		C3-1																
		B3-4																
		B3-1																
		K4-1																
		H4-4																
		H4-1																
		G4-4																
		G4-1																

Analyst: N. DelHierro Date: 2/26/18

OT 15 ✓

✓XDM

TEM Asbestos Structure Count Bench Sheet

QC Type: Not QC

Lab Job Number: A180017

Client Sample Number: WH-10008 ✓

Lab Sample ID: A180017-09

GO #	Grid	Grid Opening	Structure Type (ND, F, B, CD, CB, CF, MD, etc.)	Number of Structures		Structure Dimensions (µm)		ID Method (ADX, CD, NAM, etc.)	Mineral Class (check one)				Sketch/ Comments	Mineral ID (WRTA, AC, TR, AT, AM, AN, CH, CR, PY, OT, UN)	EDXA Observation (NaK, NaX, XK, XX, NA)	Record number of spectrum or photo if taken		Check if GO not analyzed for Chrysotile
				Primary	Total	Length	Width		LA	OA	CH	NAM				Photo	EDXA (spectrum saved)	
	B13	F4-4	ND															
	↓	F4-1	↓															
		E4-4																
		E4-1																
		C4-4																
		C4-1																
		B4-4																
		B4-1																
		A4-4																
		H5-6																
		H5-3																
		G5-6																
		G5-3																
		F5-6																
		F5-3																

Analyst: N. DelHierro

Date: 2/26/18

07/15 —

✓TDM

TEM Asbestos Structure Count Bench Sheet

QC Type: Not QC

Lab Job Number: A180017

Client Sample Number: WH-10008

Lab Sample ID: A180017-09

GO #	Grid	Grid Opening	Structure Type (ND, F, B, CD, CB, CF, MD, etc.)	Number of Structures		Structure Dimensions (µm)		ID Method (ADX, CD, NAM, etc.)	Mineral Class (check one)				Sketch/ Comments	Mineral ID (WRTA, AC, TR, AT, AM, AN, CH, CR, PY, OT, UN)	EDXA Observation (NaK, NaX, XK, XX, NA)	Record number of spectrum or photo if taken		Check if GO not analyzed for Chrysotile
				Primary	Total	Length	Width		LA	OA	CH	NAM				Photo	EDXA (spectrum saved)	
	B13	E5-6	ND															
82	↓	E5-3	↓															

Analyst: N. DelHierro

Date: 2/26/18

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TDM

TEM Asbestos Structure Count Bench Sheet

Laboratory Name	ESATR8
Site or Project Name	Libby 08BC [OU3]
Client	USEPA Region 8
Chain of Custody Number	021318CL01
Lab Job Number	A180017
Lab Sample ID	A180017-11
Client Sample Number	WH-10010
Tag	AL1
Lab Receipt Date	02/15/2018
Analysis Method	TEM-ISO
Sample Matrix	Air
Sample Type (field, blank, etc.)	Field Sample
QC Type	Not QC
Analysis Status	Analyzed
Prepared By	D. Kent
Preparation Date	02/16/2018
Volume (L) or Area (cm²)	120
Lab Comments	
Grid Prep Acceptable? Y or N (explain)	

Circle Prep Type:	Direct Indirect Indirect-Ashed
Loose Material in cowl?	Y N
Est. Filter Particulate Loading (%)	5
Instrument	JEOL JEM-1011 (C24)
Voltage (kV)	100
Magnification (X)	5,000
Primary Filter Area (mm²)	385
Primary Filter Pore Size (µm)	0.8
Sec Filter Area (mm²)	-
Sec Filter Pore Size (µm)	-
Grid Opening Area (mm²)	0.0103
Number of Grids Prepared	3
Archive Filter(s) Location	ESATR8
Grid Storage Location	ESATR8
Grid Box	B8
Grid Slots	A14, B14, A15
Filter Type	MCE

Minimum Aspect Ratio	3:1
Minimum Length (µm)	> 5
Minimum Width (µm)	0.25
Max # Structures	25
Max # Grid Openings	331
Target Analytical Sensitivity (s/cc)	0.0038
# of GO's to Reach Target AS	82
GO Traverse Direction (V or H)	H
GO Orientation (Sketch letter F)	F, F

F-Factor Calculation (if applicable)

Indirect Fraction Primary Filter	-
Analysis Aliquot 1 (mL)	-
Analysis Volume 1 (ml)	-
Indirect Fraction Secondary Filter	-
Analysis Aliquot 2 (mL)	-
Analysis Volume 2 (mL)	-
Analysis Aliquot 3 (mL)	-
Analysis Volume 3 (mL)	-
F-Factor	1

GO #	Grid	Grid Opening	Structure Type (ND, F, B, CD, CB, CF, MD, etc.)	Number of Structures: Primary	Number of Structures: Total	Structure Dimensions (µm): Length	Structure Dimensions (µm): Width	ID Method (ADX, CD, NAM, etc.)	Mineral Class (check one): LA	OA	CH	NAM	Sketch/ Comments	Mineral ID (WRTA, AC, TR, AT, AM, AN, CH, CR, PY, OT, UN)	EDXA Observation (NaK, NaX, XK, XX, NA)	Record number of spectrum or photo if taken: Photo	EDXA (spectrum saved)	Check if GO not analyzed for Chrysotile
	A14	C4-1	ND															
	↓	C4-3	↓															
		C4-4																
		C4-6																
	↓	E3-1	↓															

0/5 Analyst: D. Kent

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Date: 02/26/18

TDM

TEM Asbestos Structure Count Bench Sheet

QC Type: Not QC

Lab Job Number: A180017

Client Sample Number: WH-10010 ✓

Lab Sample ID: A180017-11

GO #	Grid	Grid Opening	Structure Type (ND, F, B, CD, CB, CF, MD, etc.)	Number of Structures		Structure Dimensions (µm)		ID Method (ADX, CD, NAM, etc.)	Mineral Class (check one)				Sketch/ Comments	Mineral ID (WRTA, AC, TR, AT, AM, AN, CH, CR, PY, OT, UN)	EDXA Observation (NaK, NaX, XK, XX, NA)	Record number of spectrum or photo if taken		Check if GO not analyzed for Chrysotile
				Primary	Total	Length	Width		LA	OA	CH	NAM				Photo	EDXA (spectrum saved)	
	A14	E3-3	ND															
		E3-4																
		E3-6																
		E4-1																
		E4-3																
		E4-4																
		E4-6																
		E5-1																
		E5-3																
		E5-4																
		E5-6																
		F3-1																
		F3-3																
		F3-4																
		F3-6																

Analyst: D. Kent

Date: 02/26/18

0/15 ✓

✓ TDM

TEM Asbestos Structure Count Bench Sheet

QC Type: Not QC

Lab Job Number: A180017 Client Sample Number: WH-10010 Lab Sample ID: A180017-11

GO #	Grid	Grid Opening	Structure Type (ND, F, B, CD, CB, CF, MD, etc.)	Number of Structures		Structure Dimensions (µm)		ID Method (ADX, CD, NAM, etc.)	Mineral Class (check one)				Sketch/ Comments	Mineral ID (WRTA, AC, TR, AT, AM, AN, CH, CR, PY, OT, UN)	EDXA Observation (NaK, NaX, XK, XX, NA)	Record number of spectrum or photo if taken		Check if GO not analyzed for Chrysotile
				Primary	Total	Length	Width		LA	OA	CH	NAM				Photo	EDXA (spectrum saved)	
	A14	F4-1	ND															
		F4-3																
		F4-4																
		F4-6																
		F5-1																
		F5-3																
		F5-4																
		F5-6																
		G3-1																
		G3-3																
		G3-4																
		G3-6																
		G4-1																
		G4-3	F	0	0	7.5	1.8	NAM				X	High Al	UN	XX		NAM-1	
		G4-4	ND															

Analyst: D. Kent

Date: 02/26/18

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TDM

TEM Asbestos Structure Count Bench Sheet

QC Type: Not QC

Lab Job Number: A180017

Client Sample Number: WH-10010 ✓

Lab Sample ID: A180017-11

GO #	Grid	Grid Opening	Structure Type (ND, F, B, CD, CB, CF, MD, etc.)	Number of Structures		Structure Dimensions (µm)		ID Method (ADX, CD, NAM, etc.)	Mineral Class (check one)				Sketch/ Comments	Mineral ID (WRTA, AC, TR, AT, AM, AN, CH, CR, PY, OT, UN)	EDXA Observation (NaK, NaX, XK, XX, NA)	Record number of spectrum or photo if taken		Check if GO not analyzed for Chrysotile
				Primary	Total	Length	Width		LA	OA	CH	NAM				Photo	EDXA (spectrum saved)	
	A14	G4-6	ND															
		G5-1																
		G5-3																
		G5-4																
40		G5-6																
		H4-1																
		H4-3																
		H4-4																
44		H4-6																
✓	B14	C3-1																
		C3-3																
		C3-4																
		C3-6																
		C4-1																
		C4-3																

Analyst: D. Kent

Date: 02/26/18

0/15 ✓

✓ TDM

TLF-12.01
Effective Date: 07/03/2014

TEM Asbestos Structure Count Bench Sheet

QC Type: Not QC

Lab Job Number: A180017

Client Sample Number: WH-10010

Lab Sample ID: A180017-11

GO #	Grid	Grid Opening	Structure Type (ND, F, B, CD, CB, CF, MD, etc.)	Number of Structures		Structure Dimensions (µm)		ID Method (ADX, CD, NAM, etc.)	Mineral Class (check one)				Sketch/ Comments	Mineral ID (WRTA, AC, TR, AT, AM, AN, CH, CR, PY, OT, UN)	EDXA Observation (NaK, NaX, XK, XX, NA)	Record number of spectrum or photo if taken		Check if GO not analyzed for Chrysotile
				Primary	Total	Length	Width		LA	OA	CH	NAM				Photo	EDXA (spectrum saved)	
	B14	C4-4	ND															
		C4-6																
		C5-1																
		C5-3																
		C5-4																
56		C5-6																
		E3-1																
		E3-3																
		E3-4																
		E3-6	F	1	1	8.2	1.2	ADX	X				XGBLD	WRTA	NaK	643	1-WRTA	
		E4-1	ND															
		E4-3																
		E4-4																
		E4-6																
		E5-1																

Analyst: D. Kent

Date: 02/26/18

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TDM

TEM Asbestos Structure Count Bench Sheet

QC Type: Not QC

Lab Job Number: A180017

Client Sample Number: WH-10010 ✓

Lab Sample ID: A180017-11

GO #	Grid	Grid Opening	Structure Type (ND, F, B, CD, CB, CF, MD, etc.)	Number of Structures		Structure Dimensions (µm)		ID Method (ADX, CD, NAM, etc.)	Mineral Class (check one)				Sketch/ Comments	Mineral ID (WRTA, AC, TR, AT, AM, AN, CH, CR, PY, OT, UN)	EDXA Observation (NaK, NaX, XK, XX, NA)	Record number of spectrum or photo if taken		Check if GO not analyzed for Chrysotile
				Primary	Total	Length	Width		LA	OA	CH	NAM				Photo	EDXA (spectrum saved)	
	B14	E5-3	ND															
		E5-4																
		E5-6																
		F3-1																
		F3-3																
		F3-4																
		F3-6																
		F4-1																
		F4-3																
		F4-4																
		F4-6																
		F5-1																
		F5-3																
		F5-4																
		F5-6																

Analyst: D. Kent

Date: 02/26/18

0/15

✓TDM

TLF-12.01
Effective Date: 07/03/2014

TEM Asbestos Structure Count Bench Sheet

QC Type: Not QC

Lab Job Number: A180017

Client Sample Number: WH-10010 ✓

Lab Sample ID: A180017-11

GO #	Grid	Grid Opening	Structure Type (ND, F, B, CD, CB, CF, MD, etc.)	Number of Structures		Structure Dimensions (µm)		ID Method (ADX, CD, NAM, etc.)	Mineral Class (check one)				Sketch/ Comments	Mineral ID (WRTA, AC, TR, AT, AM, AN, CH, CR, PY, OT, UN)	EDXA Observation (NaK, NaX, XK, XX, NA)	Record number of spectrum or photo if taken		Check if GO not analyzed for Chrysotile
				Primary	Total	Length	Width		LA	OA	CH	NAM				Photo	EDXA (spectrum saved)	
	B14	G5-1	ND															
		G5-3																
		G5-4																
84		G5-6																

SK 2/26/18

Analyst: D. Kent

Date: 02/26/18

0/4 ✓

✓TDM

Stantec

ATTACHMENT D
APTIM VALIDATED DATA REPORTS

APTIM Federal Services, LLC
QATS Program
2700 Chandler Avenue
Las Vegas, Nevada 89120

October 24, 2017

David Berry
USEPA Region 8
1595 Wynkoop Street (8EPR-SR)
Denver, CO 80202-1129

Document ID #: 1021-10242017-2

Dear Mr. Berry:

EPA CONTRACT NUMBER EP-W-16-016
TASK ORDER NUMBER 1021
QA SUPPORT FOR RI/FS AT THE LIBBY ASBESTOS SITE OU3

Enclosed please find the Release of Validated Data Report for the validation of Transmission Electron Microscopy (TEM) ISO 10312 air sample data, Laboratory Job Number A170233. The five (5) air samples associated with these data were analyzed by TechLaw, Inc. ESAT Region 8 in Golden, CO for the Libby OU3 2017 Air Curtain Burner Study. This report and accompanying appendices are deliverables under Task 07 of the subject Task Order.

If you have any questions, please feel free to contact me.

Sincerely,

Lyndsay K. Gensler
Task Leader, QATS Program
Phone: 702-895-8730
E-Mail Address: lyndsay.gensler@aptim.com
APTIM Federal Services, LLC

cc: QATS Task Order Contract Officer Representative (EPA ASB)
Administrative Contracting Officer (letter only)

APTIM

RELEASE OF VALIDATED DATA

DATE:	10/24/2017
SUBJECT:	Review of Data for Laboratory Job Number: A170233
LABORATORY:	TechLaw, Inc. ESAT Region 8, Golden, CO
FROM:	Quality Assurance Technical Support (QATS) Program, Las Vegas, NV APTIM Federal Services, LLC
TO:	David Berry, Environmental Protection Agency

QATS personnel reviewed the data for the following case:

Applicable SAP:	ACBOU3-0617, Revision 0
Chain-of-Custody Number:	230617JK01
Method:	Transmission Electron Microscopy (TEM) ISO 10312
Applicable Laboratory Modification(s):	LB-000016, LB-000029, LB-000066, LB-000067, LB-000085, and LB-000091
Number and Type of Samples:	5 Air Samples
EPA Sample Numbers:	AC-00002, AC-00004, AC-00006, AC-00008, AC-00009

VALIDATION SUMMARY

Five (5) air samples from Laboratory Job Number A170233, were collected on 06/21/2017 and shipped to the TechLaw, Inc. ESAT Region 8 laboratory in Golden, CO for TEM analysis by ISO 10312. The samples were received at the laboratory intact on 06/27/2017, and were analyzed between 06/28/2017 and 07/06/2017.

Listed below are the Data Qualification Summary Table, EDD/Bench Sheet Discrepancy Table, Data Qualifier Table, and Reason Code Table. Note that no data from this data set were qualified.

DATA QUALIFICATION SUMMARY TABLE

Criteria Exceeded	EPA Sample ID	Validation Qualifier	Reason Code
None.			

EDD/BENCH SHEET DISCREPANCY TABLE

EPA Sample ID	C# *	Method/Matrix	Lab. Job No.	Analysis Date	Discrepancy
None.					

'*' The EDD correction number in column 2. (i.e., C0, C1, C2, etc..)

DATA QUALIFIER TABLE

Qualifier	Definition
J	The result is estimated. The associated numerical value is an approximation.
UJ	The non-detect result may be inaccurate or imprecise due to the quality of the data generated because certain QC criteria were not met.
R	The sample results are rejected due to serious deficiencies.
X	Validator defined.

TEM REASON CODE TABLE

Reason Code	Definition
MC	Structure/fiber counts and recorded structure dimensions may be inaccurate due to improper or infrequent scope alignment and/or magnification calibrations.
IC	Identification by elemental composition or diffraction pattern may be inaccurate due to improper or infrequent EDXA or camera constant calibration.
PA	Structure/fiber counts and reported concentrations may be inaccurate due to improper or infrequent calibration of the plasma asher.
SC	The reported concentration may be inaccurate due to the condition of samples upon receipt at the laboratory.
DL	The area analyzed, structures counted, or AS do not meet the requirements specified in the applicable SAP Analytical Summary.
ID	The asbestos identification and concentrations may be inaccurate because the recorded structure types are not consistent with those described in the applicable TEM Method and/or laboratory modification(s).

VALIDATION PROCESS

The samples for Laboratory Job Number A170233 were collected from the subject site on 06/21/2017. All samples were prepared and analyzed in accordance with TEM ISO 10312 and SAP ACBOU3-0617, Rev. 0. The Quality Assurance Technical Support (QATS) Program performed validation and a transcription check in accordance with Libby-specific data validation SOPs. Preparation of this report was performed under Technical Direction 02, Task 07, of Task Order 1021.

The sample results on bench sheets and other supporting documents provided in the hardcopy deliverables were compared to the entries in the associated laboratory method-specific EDDs to ensure that the reported results are complete, compliant with the specified methodology, and accurate. Additional support information provided in this data validation report include the QATS Data Review Checklist used to document the data validation process (see Appendix A); and the sample results as reported by the laboratory, with qualifiers as applicable (see Appendix B).

TEM VALIDATION SUMMARY

1. **DATA PACKAGE INVENTORY AND SAMPLE RECEIPT:** The data package included a narrative, Chain-of-Custody (COC) record, EDD files, raw data (bench sheets), and QC samples. The samples were properly packaged, sealed, undamaged, labeled, and were not shipped or stored with bulk samples (air samples only) upon receipt at the laboratory. The COC record was reviewed and found to be acceptable. Note that a benchsheet error was identified in the initial review performed on 09/28/2017, and the laboratory was notified. The laboratory corrected and submitted the revised analytical benchsheet as a supplement on the same day, and therefore, no EDD/benchsheet discrepancy is assigned.

2. **SAMPLE PREPARATION:** No preparation documents were provided.

3. **EQUIPMENT CALIBRATION AND PERFORMANCE CHECKS (i.e., daily microscope alignment, screen magnification, EDS calibration, and sensitivity checks):** The equipment alignment and calibration documentation provided separately were performed at the correct frequency, indicating that the instruments were in proper working order during the time of sample analyses.

4. **ANALYTICAL SENSITIVITY:** A sufficient number of grid openings have been analyzed to achieve the required analytical sensitivity and/or the appropriate stopping rule was invoked.

5. **STRUCTURE RECORDING AND ASBESTOS IDENTIFICATION:** No structures were observed in this sample set.

6. **BLANK ANALYSIS:** One laboratory blank and one field blank (EPA Sample No. AC-00009) were analyzed and reported with this sample set. There were no structures recorded. Note: Blanks are reviewed and evaluated on a program-wide basis. Qualification for blank contamination is generally not applied during the validation process.

7. **ANALYTICAL VARIABILITY:** The laboratory performed one recount different (RD) analysis on EPA Sample No. AC-00008 and one re-preparation (RP) analysis on EPA Sample No. AC-00006. Note: QC samples are reviewed and evaluated on a program-wide basis. Qualification for discordant results is not applied during the validation process.

8. **LABORATORY MODIFICATIONS:** Laboratory Modifications LB-000016, LB-000029, LB-000066, LB-000067, LB-000085, and LB-000091 were associated with this sample set.

9. **OVERALL ASSESSMENT OF DATA:** The deliverable was found to be complete and accurate. No structures were found in the field samples and blanks. No qualification of the data is necessary.

REVIEWED BY: Michael Lenkauskas DATE: 10/02/2017

Appendix A

Data Review Checklist

Data Review Checklist for the Validation of Libby Transmission Electron Microscopy (TEM) Data Deliverables

Project Name: Libby OU3 2017 Air Curtain Burner Study	**Laboratory Job No: A170233**
Number of Samples/Matrix: 5 Air Samples	**Laboratory: TechLaw, Inc. ESATR8, Golden, CO**
TEM Method/SOP: TEM ISO 10312	**SAP Number: ACBOU3-0617, Revision 0**
Laboratory Modifications: LB-000016, LB-000029, LB-000066, LB-000067, LB-000085, and LB-000091	

1.0 Data Package Inventory	**Yes**	**No**	**Comments**
1.1 Were the project-specific requirements provided in the SAP Analytical Summary submitted with the data package?	☒	☐	SAP/QAPP ACBOU3-0617, Rev. 0 is included in the data package.
1.2 Did the received hard copy deliverables contain all the necessary components:			
1.2.1 Narrative?	☒	☐	
1.2.2 Chain-of-Custody?	☒	☐	
1.2.3 EDD file?	☒	☐	
1.2.4 Raw Data - Bench Sheets?	☒	☐	
1.2.5 QC Sample Data:			
1.2.5.1 Blank(s)?	☒	☐	One laboratory blank (LB) and one field blank (EPA Sample No. AC-00009).
1.2.5.2 Recount Same (RS)?	☐	☒	
1.2.5.3 Recount Different (RD)?	☒	☐	
1.2.5.4 Verified Analysis (VA)?	☐	☒	One RD (EPA Sample No. AC-00008) and one RP (EPA Sample No. AC-00006)
1.2.5.5 Repreparation (RP)?	☒	☐	
1.2.6 Calibration Data (submitted quarterly)?	☒	☐	Supplement with revised analytical benchsheet (verification finding).
1.2.7 Communication Records?	☒	☐	
1.2.8 Miscellaneous?	☒	☐	
2.0 Chain-of-Custody Information			
2.1 Was the following information recorded in the hard copy electronic deliverables (if applicable) and is it consistent with the information recorded on the COC:			
2.1.1 COC Number?	☒	☐	COC #230617JK01
2.1.2 Case or Sample Set Number?	☒	☐	
2.1.3 EPA Sample ID?	☒	☐	
2.1.4 Date/Time Collected?	☒	☐	
2.1.5 Sample Volume?	☒	☐	
2.1.6 Sample Matrix?	☒	☐	
2.1.7 Analyses (Method)?	☒	☐	
2.1.8 Date/Time Received?	☒	☐	
2.1.9 Other (describe)?	☐	☐	NA
2.2 Were the COC records signed and dated upon receipt?	☒	☐	

Additional Comments:

Data Review Checklist for the Validation of Libby Transmission Electron Microscopy (TEM) Data Deliverables

3.0 Sample Result Validation	Yes	No	Comments
3.1 Is the sample preparation method documented and final sample volume recorded?	☒	☐	
3.2 Were the correct number of grid openings used to achieve the specified analytical sensitivity and/or were associated stopping rules invoked?	☒	☐	
3.3 Verify that the following information from the laboratory's bench sheets have been transcribed correctly:			
3.3.1.1 Grid identification?	☒	☐	
3.3.1.2 Grid opening?	☒	☐	
3.3.1.3 Structure type?	☐	☒	All samples were reported as non-detect (ND).
3.3.1.4 Number of primary and secondary structures?	☐	☒	
3.3.1.5 Length and width dimensions?	☐	☒	
3.3.1.6 Structure identification?	☐	☒	
3.3.1.7 Mineral type?	☐	☒	
3.4 Are overloaded samples correctly reported to the specified percent obscuration (i.e. 10%, 25%)?	☐	☒	No samples determined to be overloaded.
3.5 If overloading or uneven loading occurs, or the filters contain loose debris, are samples prepared by an alternate method (i.e. indirect preparation)?	☐	☐	NA
3.6 Verify that the following information is documented correctly:			
3.6.1 Magnification?	☒	☐	
3.6.2 Field or QC sample type?	☒	☐	
3.6.3 Number of grids prepared?	☒	☐	
3.6.4 Filter area in (mm^2)?	☒	☐	
3.6.5 Analysis/preparation date?	☒	☐	
3.7 Verify the totals reported on the count sheets for the various types of structures are correct.	☒	☐	No structures found in any of these samples.
3.8 Are the required spectra included for all hits reported (i.e. ED, EDXA, SAED)?	☐	☐	NA

Additional Comments:

Data Review Checklist for the Validation of Libby Transmission Electron Microscopy (TEM) Data Deliverables

4.0 Quality Control Validation	Yes	No	Comments
4.1 Blanks (if applicable)			
4.1.1 Are laboratory blanks (direct, indirect) prepared, analyzed and reported with the sample set?	☒	☐	One LB and one field blank (EPA Sample No. AC-00009) were performed. No structures were found.
4.1.2 Are any structures observed in the blanks?	☐	☒	
Note: Laboratory Blanks are also reviewed and evaluated on a program wide basis. Qualification is generally not applied during the validation process; however, the field blanks reported with the sample set can be directly associated with the samples in the sample set and qualification may apply.			
4.2 Recount Same (RS)			
4.2.1 Are recounts same (same analyst on the same grids and grid openings) sample analyses performed and reported with the sample set?	☐	☒	
4.3 Recount Different (RD)			
4.3.1 Are recounts different (different analyst on the same grids and grid openings) sample analyses performed and reported with the sample set?	☒	☐	One RD was performed on EPA Sample No. AC-00008.
4.4 Verified Analyses (VA)			
4.4.1 Are verified analyses (second analysis on same grids and grid openings) performed and reported with the sample set?	☐	☒	
4.5 Repreparation (RP)			
4.5.1 Are repreparation analyses (different analyst on reprepared grids and grid openings) performed and reported with the sample set?	☐	☒	One RP was performed on EPA Sample No. AC-00006.
Note: RS, RD, VA, and RP analyses are reviewed and evaluated on a program wide basis. Qualification is not applied during the validation process; however, the QC samples reported with the sample set are listed in the validation report.			

Additional Comments:

Data Review Checklist for the Validation of Libby Transmission Electron Microscopy (TEM) Data Deliverables

5.0 Calibration & Microscope Alignment Validation	**Yes**	**No**	**Comments**
5.1 Is evidence of the calibration of TEM Screen Magnification provided for all sample analyses?	☒	☐	
5.1.1 Daily Alignment and Cu/Al Calibration?	☒	☐	
5.1.2 Camera Constant Calibration?	☒	☐	
5.1.3 k-Factors?	☒	☐	
5.1.4 Plasma Asher?	☒	☐	
5.2 Are the calibration checks listed above performed at the required frequencies?	☒	☐	
5.3 Are the calibration checks within the specified criteria?	☒	☐	
5.4 Are all calibration checks traceable to the associated samples analyses?	☒	☐	
5.5 If required, are the following additional system checks provided:			
5.5.1 Beam Dose Check?	☒	☐	
5.5.2 Spot Size Check?	☒	☐	
5.5.3 Detector Resolution Check?	☒	☐	
5.5.4 If "no" then qualify the associated results in accordance with the Microscope Alignment and Instrument/Standard Calibration tables in SOP QATS-70-095.			
6.0 Case Narrative Validation			
6.1 Does the data package narrative include descriptions of the following:			
6.1.1 Samples received (matrix/method)?	☒	☐	
6.1.2 Method/Laboratory Modifications?	☒	☐	
6.1.3 Example sample calculation?	☒	☐	
6.1.4 Laboratory blank contamination?	☐	☒	
6.1.5 Quality control analyses outside specified criteria?	☐	☒	
6.1.6 Any problems encountered and subsequent corrective action?	☒	☐	Supplement with revised analytical benchsheet.

Additional Comments:

Validated By: **Michael Lenkauskas** **Date** **10/02/2017**

QA Review: **Lyndsay Gensler** **Date** **10/09/2017**

Appendix B

Qualified Result Forms

230617JK01_AC-00002_A170233-02_TEM-ISO_AR_06-28-17_D_NotQC_C0.xlsm
Version Air-DustEDD_38n

LIBBY
TEM Asbestos Structure Count -- ISO 10312

EPA Sample Number	AC-00002
Tag	AL1
Status	ANALYZED
Lab QC Type	NOT QC
Lab Sample Number	A170233-02
Matrix	Air
Category	Field
Prep	Direct
Analysis Method	TEM-ISO
Est. Particulate Loading	2%

PARAMETERS		
Effective filter area	385.0	mm2
F factor	1.00E+00	
Number of Grid Openings (amphibole)	4	
Number of Grid Openings (chrysotile)	4	
Grid opening area	0.010	mm2
Volume (L) or Area (cm2)	542	L
Sensitivity (amphibole)	1.72E-02	s/cc
Sensitivity (chrysotile)	1.72E-02	s/cc
Area Examined (amphibole)	0.041	mm2
Area Examined (chrysotile)	0.041	mm2

Magnification: LOW

Recording Rules:	Min AR	Min length (um)	Min width (um)
	3:1	5	0.25

Stopping Rules:	Target Sens.	Max AE (mm^2)	Max N LA
	0.033	0.500	25

COUNTS (based on countable structures only)

Bin	LA	OA	CH	All Asbestos
Total				
PCME	0	0	0	0

CONCENTRATION (s/cc)

Bin	LA	OA	CH	All Asbestos
Total				
PCME	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Total: Length > 0.5 um, Aspect Ratio >= 3:1
PCME: Length > 5 um, Width >= 0.25 um, Aspect Ratio >= 3:1

Chi-sq test for filter loading --
p value: 1.0E+00
interpretation: OK

230617JK01_AC-00004_A170233-04_TEM-ISO_AR_06-28-17_D_NotQC_C0.xlsm
Version Air-DustEDD_38n

LIBBY
TEM Asbestos Structure Count -- ISO 10312

EPA Sample Number	AC-00004
Tag	AL1
Status	ANALYZED
Lab QC Type	NOT QC
Lab Sample Number	A170233-04
Matrix	Air
Category	Field
Prep	Direct
Analysis Method	TEM-ISO
Est. Particulate Loading	5%

PARAMETERS		
Effective filter area	385.0	mm2
F factor	1.00E+00	
Number of Grid Openings (amphibole)	4	
Number of Grid Openings (chrysotile)	4	
Grid opening area	0.010	mm2
Volume (L) or Area (cm2)	551	L
Sensitivity (amphibole)	1.70E-02	s/cc
Sensitivity (chrysotile)	1.70E-02	s/cc
Area Examined (amphibole)	0.041	mm2
Area Examined (chrysotile)	0.041	mm2

Magnification: LOW

Recording Rules:	Min AR	Min length (um)	Min width (um)
	3:1	5	0.25

Stopping Rules:	Target Sens.	Max AE (mm^2)	Max N LA
	0.033	0.500	25

COUNTS (based on countable structures only)

Bin	LA	OA	CH	All Asbestos
Total				
PCME	0	0	0	0

CONCENTRATION (s/cc)

Bin	LA	OA	CH	All Asbestos
Total				
PCME	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Total: Length > 0.5 um, Aspect Ratio >= 3:1
PCME: Length > 5 um, Width >= 0.25 um, Aspect Ratio >= 3:1

Chi-sq test for filter loading --
p value: 1.0E+00
interpretation: OK

230617JK01_AC-00006_A170233-06_TEM-ISO_AR_06-28-17_D_NotQC_C0.xlsm
Version Air-DustEDD_38n

LIBBY
TEM Asbestos Structure Count -- ISO 10312

EPA Sample Number	AC-00006
Tag	AL1
Status	ANALYZED
Lab QC Type	NOT QC
Lab Sample Number	A170233-06
Matrix	Air
Category	Field
Prep	Direct
Analysis Method	TEM-ISO
Est. Particulate Loading	4%

PARAMETERS		
Effective filter area	385.0	mm2
F factor	1.00E+00	
Number of Grid Openings (amphibole)	4	
Number of Grid Openings (chrysotile)	4	
Grid opening area	0.010	mm2
Volume (L) or Area (cm2)	531	L
Sensitivity (amphibole)	1.76E-02	s/cc
Sensitivity (chrysotile)	1.76E-02	s/cc
Area Examined (amphibole)	0.041	mm2
Area Examined (chrysotile)	0.041	mm2

Magnification: LOW

Recording Rules:	Min AR	Min length (um)	Min width (um)
	3:1	5	0.25

Stopping Rules:	Target Sens.	Max AE (mm^2)	Max N LA
	0.033	0.500	25

COUNTS (based on countable structures only)

Bin	LA	OA	CH	All Asbestos
Total				
PCME	0	0	0	0

CONCENTRATION (s/cc)

Bin	LA	OA	CH	All Asbestos
Total				
PCME	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Total: Length > 0.5 um, Aspect Ratio >= 3:1
PCME: Length > 5 um, Width >= 0.25 um, Aspect Ratio >= 3:1

Chi-sq test for filter loading --
p value: 1.0E+00
interpretation: OK

230617JK01_AC-00008_A170233-08_TEM-ISO_AR_06-28-17_D_NotQC_C0.xlsm
Version Air-DustEDD_38n

LIBBY
TEM Asbestos Structure Count -- ISO 10312

EPA Sample Number	AC-00008
Tag	AL1
Status	ANALYZED
Lab QC Type	NOT QC
Lab Sample Number	A170233-08
Matrix	Air
Category	Field
Prep	Direct
Analysis Method	TEM-ISO
Est. Particulate Loading	9%

PARAMETERS		
Effective filter area	385.0	mm2
F factor	1.00E+00	
Number of Grid Openings (amphibole)	4	
Number of Grid Openings (chrysotile)	4	
Grid opening area	0.010	mm2
Volume (L) or Area (cm2)	540	L
Sensitivity (amphibole)	1.73E-02	s/cc
Sensitivity (chrysotile)	1.73E-02	s/cc
Area Examined (amphibole)	0.041	mm2
Area Examined (chrysotile)	0.041	mm2

Magnification: LOW

Recording Rules:	Min AR	Min length (um)	Min width (um)
	3:1	5	0.25

Stopping Rules:	Target Sens.	Max AE (mm^2)	Max N LA
	0.033	0.500	25

COUNTS (based on countable structures only)

Bin	LA	OA	CH	All Asbestos
Total				
PCME	0	0	0	0

CONCENTRATION (s/cc)

Bin	LA	OA	CH	All Asbestos
Total				
PCME	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Total: Length > 0.5 um, Aspect Ratio >= 3:1
PCME: Length > 5 um, Width >= 0.25 um, Aspect Ratio >= 3:1

Chi-sq test for filter loading --
p value: 1.0E+00
interpretation: OK

230617JK01_AC-00009_A170233-09_TEM-ISO_AR_06-28-17_D_NotQC_C0.xlsm
Version Air-DustEDD_38n

LIBBY
TEM Asbestos Structure Count -- ISO 10312

EPA Sample Number	AC-00009
Tag	AL1
Status	ANALYZED
Lab QC Type	NOT QC
Lab Sample Number	A170233-09
Matrix	Air
Category	Blank
Prep	Direct
Analysis Method	TEM-ISO
Est. Particulate Loading	1%

PARAMETERS		
Effective filter area	385.0	mm2
F factor	1.00E+00	
Number of Grid Openings (amphibole)	98	
Number of Grid Openings (chrysotile)	98	
Grid opening area	0.010	mm2
Volume (L) or Area (cm2)	0	L
Sensitivity (amphibole)	Blank	s/cc
Sensitivity (chrysotile)	Blank	s/cc
Area Examined (amphibole)	1.009	mm2
Area Examined (chrysotile)	1.009	mm2

Magnification: LOW

Recording Rules:	Min AR	Min length (um)	Min width (um)
	3:1	5	0.25

Stopping Rules:	Target Sens.	Max AE (mm^2)	Max N LA
		1.000	

COUNTS (based on countable structures only)

Bin	LA	OA	CH	All Asbestos
Total				
PCME	0	0	0	0

CONCENTRATION (s/cc)

Bin	LA	OA	CH	All Asbestos
Total				
PCME				

Total: Length > 0.5 um, Aspect Ratio >= 3:1
PCME: Length > 5 um, Width >= 0.25 um, Aspect Ratio >= 3:1

Chi-sq test for filter loading --
p value: 1.0E+00
interpretation: OK

230617JK01_AC-00006_A170233-06_TEM-ISO_AR_07-06-17_D_RP_C0.xlsm

LIBBY

Version Air-DustEDD_38n

TEM Asbestos Structure Count -- ISO 10312

EPA Sample Number	AC-00006
Tag	AL1
Status	ANALYZED
Lab QC Type	Repreparation
Lab Sample Number	A170233-06
Matrix	Air
Category	Field
Prep	Direct
Analysis Method	TEM-ISO
Est. Particulate Loading	5%

PARAMETERS		
Effective filter area	385.0	mm2
F factor	1.00E+00	
Number of Grid Openings (amphibole)	4	
Number of Grid Openings (chrysotile)	4	
Grid opening area	0.010	mm2
Volume (L) or Area (cm2)	531	L
Sensitivity (amphibole)	1.76E-02	s/cc
Sensitivity (chrysotile)	1.76E-02	s/cc
Area Examined (amphibole)	0.041	mm2
Area Examined (chrysotile)	0.041	mm2

Magnification:	LOW

Recording Rules:

Min AR	Min length (um)	Min width (um)
3:1	5	0.25

Stopping Rules:

Target Sens.	Max AE (mm^2)	Max N LA
0.033	0.500	25

COUNTS (based on countable structures only)

Bin	LA	OA	CH	All Asbestos
Total				
PCME	0	0	0	0

CONCENTRATION (s/cc)

Bin	LA	OA	CH	All Asbestos
Total				
PCME	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Total: Length > 0.5 um, Aspect Ratio >= 3:1

PCME: Length > 5 um, Width >= 0.25 um, Aspect Ratio >= 3:1

Chi-sq test for filter loading --

p value: 1.0E+00

interpretation: OK

230617JK01_AC-00008_A170233-08_TEM-ISO_AR_07-06-17_D_RD_C0.xlsm
Version Air-DustEDD_38n

LIBBY
TEM Asbestos Structure Count -- ISO 10312

EPA Sample Number	AC-00008
Tag	AL1
Status	ANALYZED
Lab QC Type	Recount Different
Lab Sample Number	A170233-08
Matrix	Air
Category	Field
Prep	Direct
Analysis Method	TEM-ISO
Est. Particulate Loading	5%

PARAMETERS		
Effective filter area	385.0	mm2
F factor	1.00E+00	
Number of Grid Openings (amphibole)	4	
Number of Grid Openings (chrysotile)	4	
Grid opening area	0.010	mm2
Volume (L) or Area (cm2)	540	L
Sensitivity (amphibole)	1.73E-02	s/cc
Sensitivity (chrysotile)	1.73E-02	s/cc
Area Examined (amphibole)	0.041	mm2
Area Examined (chrysotile)	0.041	mm2

Magnification: LOW

Recording Rules:	Min AR	Min length (um)	Min width (um)
	3:1	5	0.25

Stopping Rules:	Target Sens.	Max AE (mm^2)	Max N LA
	0.033	0.500	25

COUNTS (based on countable structures only)

Bin	LA	OA	CH	All Asbestos
Total				
PCME	0	0	0	0

CONCENTRATION (s/cc)

Bin	LA	OA	CH	All Asbestos
Total				
PCME	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Total: Length > 0.5 um, Aspect Ratio >= 3:1
PCME: Length > 5 um, Width >= 0.25 um, Aspect Ratio >= 3:1

Chi-sq test for filter loading --
p value: 1.0E+00
interpretation: OK

APTIM Federal Services, LLC
QATS Program
2700 Chandler Avenue
Las Vegas, Nevada 89120

October 24, 2017

David Berry
USEPA Region 8
1595 Wynkoop Street (8EPR-SR)
Denver, CO 80202-1129

Document ID #: 1021-10242017-1

Dear Mr. Berry:

EPA CONTRACT NUMBER EP-W-16-016
TASK ORDER NUMBER 1021
QA SUPPORT FOR RI/FS AT THE LIBBY ASBESTOS SITE OU3

Enclosed please find the Release of Validated Data Report for the validation of Transmission Electron Microscopy (TEM) ISO 10312 air sample data, Laboratory Job Number 041718445. The four (4) air samples associated with these data were analyzed by EMSL Analytical, Inc. in Cinnaminson, NJ for the Libby OU3 2017 Air Curtain Burner Study. This report and accompanying appendices are deliverables under Task 07 of the subject Task Order.

If you have any questions, please feel free to contact me.

Sincerely,

Lyndsay K. Gensler
Task Leader, QATS Program
Phone: 702-895-8730
E-Mail Address: lyndsay.gensler@aptim.com
APTIM Federal Services, LLC

cc: QATS Task Order Contract Officer Representative (EPA ASB)
Administrative Contracting Officer (letter only)

RELEASE OF VALIDATED DATA

DATE: 10/24/2017

SUBJECT: Review of Data for Laboratory Job Number: 041718445

LABORATORY: EMSL Analytical, Inc., Cinnaminson, NJ

FROM: Quality Assurance Technical Support (QATS) Program, Las Vegas, NV
APTIM Federal Services, LLC

TO: David Berry, Environmental Protection Agency

QATS personnel reviewed the data for the following case:

Applicable SAP: ACBOU3-0617, Revision 0

Chain-of-Custody Number: 230617JK02

Method: Transmission Electron Microscopy (TEM) ISO 10312

Applicable Laboratory Modification(s): LB-000016, LB-000029, LB-000066, LB-000067, LB-000085, and LB-000091

Number and Type of Samples: 4 Air Samples

EPA Sample Numbers: AC-00011, AC-00013, AC-00015, AC-00017

VALIDATION SUMMARY

Four (4) air samples from Laboratory Job Number 041718445, were collected on 06/21/2017 and shipped to EMSL Analytical, Inc. in Cinnaminson, NJ for TEM analysis by ISO 10312. The samples were received at the laboratory intact on 06/27/2017, and were analyzed on 06/28/2017.

Listed below are the Data Qualification Summary Table, EDD/Bench Sheet Discrepancy Table, Data Qualifier Table, and Reason Code Table. Note that no data from this data set were qualified.

DATA QUALIFICATION SUMMARY TABLE

Criteria Exceeded	EPA Sample ID	Validation Qualifier	Reason Code
None.			

EDD/BENCH SHEET DISCREPANCY TABLE

EPA Sample ID	C# *	Method/Matrix	Lab. Job No.	Analysis Date	Discrepancy
None.					

'*' The EDD correction number in column 2. (i.e., C0, C1, C2, etc..)

DATA QUALIFIER TABLE

Qualifier	Definition
J	The result is estimated. The associated numerical value is an approximation.
UJ	The non-detect result may be inaccurate or imprecise due to the quality of the data generated because certain QC criteria were not met.
R	The sample results are rejected due to serious deficiencies.
X	Validator defined.

TEM REASON CODE TABLE

Reason Code	Definition
MC	Structure/fiber counts and recorded structure dimensions may be inaccurate due to improper or infrequent scope alignment and/or magnification calibrations.
IC	Identification by elemental composition or diffraction pattern may be inaccurate due to improper or infrequent EDXA or camera constant calibration.
PA	Structure/fiber counts and reported concentrations may be inaccurate due to improper or infrequent calibration of the plasma asher.
SC	The reported concentration may be inaccurate due to the condition of samples upon receipt at the laboratory.
DL	The area analyzed, structures counted, or AS do not meet the requirements specified in the applicable SAP Analytical Summary.
ID	The asbestos identification and concentrations may be inaccurate because the recorded structure types are not consistent with those described in the applicable TEM Method and/or laboratory modification(s).

VALIDATION PROCESS

The samples for Laboratory Job Number 041718445 were collected from the subject site on 06/21/2017. All samples were prepared and analyzed in accordance with TEM ISO 10312 and SAP ACBOU3-0617, Rev. 0. The Quality Assurance Technical Support (QATS) Program performed validation and a transcription check in accordance with Libby-specific data validation SOPs. Preparation of this report was performed under Technical Direction 02, Task 07, of Task Order 1021.

The sample results on bench sheets and other supporting documents provided in the hardcopy deliverables were compared to the entries in the associated laboratory method-specific EDDs to ensure that the reported results are complete, compliant with the specified methodology, and accurate. Additional support information provided in this data validation report include the QATS Data Review Checklist used to document the data validation process (see Appendix A); and the sample results as reported by the laboratory, with qualifiers as applicable (see Appendix B).

TEM VALIDATION SUMMARY

1. **DATA PACKAGE INVENTORY AND SAMPLE RECEIPT:** The data package included a narrative, Chain-of-Custody (COC) record, EDD files, raw data (bench sheets), and QC samples. The samples were properly packaged, sealed, undamaged, labeled, and were not shipped or stored with bulk samples (air samples only) upon receipt at the laboratory. The COC record was reviewed and found to be acceptable.

2. **SAMPLE PREPARATION:** The appropriate preparation documents were provided.

3. **EQUIPMENT CALIBRATION AND PERFORMANCE CHECKS (i.e., daily microscope alignment, screen magnification, EDS calibration, and sensitivity checks):** The equipment alignment and calibration documentation provided separately were performed at the correct frequency, indicating that the instruments were in proper working order during the time of sample analyses.

4. **ANALYTICAL SENSITIVITY:** A sufficient number of grid openings have been analyzed to achieve the required analytical sensitivity and/or the appropriate stopping rule was invoked.

5. **STRUCTURE RECORDING AND ASBESTOS IDENTIFICATION:** The structure recording and asbestos identification were found to be acceptable.

6. **BLANK ANALYSIS:** One laboratory blank was analyzed and reported with this sample set. There were no structures recorded. Note: Blanks are reviewed and evaluated on a program-wide basis. Qualification for blank contamination is generally not applied during the validation process.

7. **ANALYTICAL VARIABILITY:** The laboratory performed one recount different (RD) analysis on EPA Sample No. AC-00015. Note: QC samples are reviewed and evaluated on a program-wide basis. Qualification for discordant results is not applied during the validation process.

8. **LABORATORY MODIFICATIONS:** Laboratory Modifications LB-000016, LB-000029, LB-000066, LB-000067, LB-000085, and LB-000091 were associated with this sample set.

9. **OVERALL ASSESSMENT OF DATA:** The deliverable was found to be complete and accurate. No qualification of the data is necessary.

REVIEWED BY: Michael Lenkauskas DATE: 09/29/2017

Appendix A

Data Review Checklist

Data Review Checklist for the Validation of Libby Transmission Electron Microscopy (TEM) Data Deliverables

Project Name: Libby OU3 2017 Air Curtain Burner Study	**Laboratory Job No: 041718445**
Number of Samples/Matrix: 4 Air Samples	**Laboratory: EMSL Analytical, Inc., Cinnaminson, NJ**
TEM Method/SOP: TEM ISO 10312	**SAP Number: ACBOU3-0617, Revision 0**
Laboratory Modifications: LB-000016, LB-000029, LB-000066, LB-000067, LB-000085, LB-000091	

1.0 Data Package Inventory	**Yes**	**No**	**Comments**
1.1 Were the project-specific requirements provided in the SAP Analytical Summary submitted with the data package?	☒	☐	SAP/QAPP ACBOU3-0617, Rev. 0 is included in the data package.
1.2 Did the received hard copy deliverables contain all the necessary components:			
1.2.1 Narrative?	☒	☐	
1.2.2 Chain-of-Custody?	☒	☐	
1.2.3 EDD file?	☒	☐	
1.2.4 Raw Data - Bench Sheets?	☒	☐	
1.2.5 QC Sample Data:			
1.2.5.1 Blank(s)?	☒	☐	One laboratory blank (LB).
1.2.5.2 Recount Same (RS)?	☐	☒	
1.2.5.3 Recount Different (RD)?	☒	☐	One RD (EPA Sample No. AC-00015).
1.2.5.4 Verified Analysis (VA)?	☐	☒	
1.2.5.5 Repreparation (RP)?	☐	☒	
1.2.6 Calibration Data (submitted quarterly)?	☒	☐	
1.2.7 Communication Records?	☐	☒	
1.2.8 Miscellaneous?	☐	☒	
2.0 Chain-of-Custody Information			
2.1 Was the following information recorded in the hard copy electronic deliverables (if applicable) and is it consistent with the information recorded on the COC:			
2.1.1 COC Number?	☒	☐	COC #230617JK02
2.1.2 Case or Sample Set Number?	☒	☐	
2.1.3 EPA Sample ID?	☒	☐	
2.1.4 Date/Time Collected?	☒	☐	
2.1.5 Sample Volume?	☒	☐	
2.1.6 Sample Matrix?	☒	☐	
2.1.7 Analyses (Method)?	☒	☐	
2.1.8 Date/Time Received?	☒	☐	
2.1.9 Other (describe)?	☐	☐	NA
2.2 Were the COC records signed and dated upon receipt?	☒	☐	

Additional Comments:

Data Review Checklist for the Validation of Libby Transmission Electron Microscopy (TEM) Data Deliverables

3.0 Sample Result Validation	Yes	No	Comments
3.1 Is the sample preparation method documented and final sample volume recorded?	☒	☐	
3.2 Were the correct number of grid openings used to achieve the specified analytical sensitivity and/or were associated stopping rules invoked?	☒	☐	
3.3 Verify that the following information from the laboratory's bench sheets have been transcribed correctly:			
3.3.1.1 Grid identification?	☒	☐	
3.3.1.2 Grid opening?	☒	☐	
3.3.1.3 Structure type?	☒	☐	
3.3.1.4 Number of primary and secondary structures?	☒	☐	
3.3.1.5 Length and width dimensions?	☒	☐	
3.3.1.6 Structure identification?	☒	☐	
3.3.1.7 Mineral type?	☒	☐	
3.4 Are overloaded samples correctly reported to the specified percent obscuration (i.e. 10%, 25%)?	☐	☒	No samples determined to be overloaded.
3.5 If overloading or uneven loading occurs, or the filters contain loose debris, are samples prepared by an alternate method (i.e. indirect preparation)?	☐	☐	NA
3.6 Verify that the following information is documented correctly:			
3.6.1 Magnification?	☒	☐	
3.6.2 Field or QC sample type?	☒	☐	
3.6.3 Number of grids prepared?	☒	☐	
3.6.4 Filter area in (mm^2)?	☒	☐	
3.6.5 Analysis/preparation date?	☒	☐	
3.7 Verify the totals reported on the count sheets for the various types of structures are correct.	☒	☐	.
3.8 Are the required spectra included for all hits reported (i.e. ED, EDXA, SAED)?	☒	☐	

Additional Comments:

Data Review Checklist for the Validation of Libby Transmission Electron Microscopy (TEM) Data Deliverables

4.0 Quality Control Validation	Yes	No	Comments
4.1 Blanks (if applicable)			
4.1.1 Are laboratory blanks (direct, indirect) prepared, analyzed and reported with the sample set?	☒	☐	One LB was performed. No structures were found.
4.1.2 Are any structures observed in the blanks?	☐	☒	
Note: Laboratory Blanks are also reviewed and evaluated on a program wide basis. Qualification is generally not applied during the validation process; however, the field blanks reported with the sample set can be directly associated with the samples in the sample set and qualification may apply.			
4.2 Recount Same (RS)			
4.2.1 Are recounts same (same analyst on the same grids and grid openings) sample analyses performed and reported with the sample set?	☐	☒	
4.3 Recount Different (RD)			
4.3.1 Are recounts different (different analyst on the same grids and grid openings) sample analyses performed and reported with the sample set?	☒	☐	One RD was performed on EPA Sample No. AC-00011.
4.4 Verified Analyses (VA)			
4.4.1 Are verified analyses (second analysis on same grids and grid openings) performed and reported with the sample set?	☐	☒	
4.5 Repreparation (RP)			
4.5.1 Are repreparation analyses (different analyst on reprepared grids and grid openings) performed and reported with the sample set?	☐	☒	
Note: RS, RD, VA, and RP analyses are reviewed and evaluated on a program wide basis. Qualification is not applied during the validation process; however, the QC samples reported with the sample set are listed in the validation report.			

Additional Comments:

Data Review Checklist for the Validation of Libby Transmission Electron Microscopy (TEM) Data Deliverables

5.0 Calibration & Microscope Alignment Validation	Yes	No	Comments
5.1 Is evidence of the calibration of TEM Screen Magnification provided for all sample analyses?	☒	☐	
5.1.1 Daily Alignment and Cu/Al Calibration?	☒	☐	
5.1.2 Camera Constant Calibration?	☒	☐	
5.1.3 k-Factors?	☒	☐	
5.1.4 Plasma Asher?	☒	☐	
5.2 Are the calibration checks listed above performed at the required frequencies?	☒	☐	
5.3 Are the calibration checks within the specified criteria?	☒	☐	
5.4 Are all calibration checks traceable to the associated samples analyses?	☒	☐	
5.5 If required, are the following additional system checks provided:			
5.5.1 Beam Dose Check?	☒	☐	
5.5.2 Spot Size Check?	☒	☐	
5.5.3 Detector Resolution Check?	☒	☐	
5.5.4 If "no" then qualify the associated results in accordance with the Microscope Alignment and Instrument/Standard Calibration tables in SOP QATS-70-095.			
6.0 Case Narrative Validation			
6.1 Does the data package narrative include descriptions of the following:			
6.1.1 Samples received (matrix/method)?	☒	☐	
6.1.2 Method/Laboratory Modifications?	☒	☐	
6.1.3 Example sample calculation?	☐	☒	
6.1.4 Laboratory blank contamination?	☐	☒	
6.1.5 Quality control analyses outside specified criteria?	☐	☒	
6.1.6 Any problems encountered and subsequent corrective action?	☐	☒	

Additional Comments:

Validated By: Michael Lenkauskas **Date** 09/29/2017

QA Review: Lyndsay Gensler **Date** 10/06/2017

Appendix B

Qualified Result Forms

230617JK02_AC-00011_041718445-0002_TEM-ISO_AR_06-28-17_D_NotQC_C0.xlsm
Version Air-DustEDD_38n

LIBBY
TEM Asbestos Structure Count -- ISO 10312

EPA Sample Number	AC-00011
Tag	AL1
Status	ANALYZED
Lab QC Type	NOT QC
Lab Sample Number	041718445-0002
Matrix	Air
Category	Field
Prep	Direct
Analysis Method	TEM-ISO
Est. Particulate Loading	3%

PARAMETERS		
Effective filter area	385.0	mm2
F factor	1.00E+00	
Number of Grid Openings (amphibole)	4	
Number of Grid Openings (chrysotile)	4	
Grid opening area	0.013	mm2
Volume (L) or Area (cm2)	540	L
Sensitivity (amphibole)	1.36E-02	s/cc
Sensitivity (chrysotile)	1.36E-02	s/cc
Area Examined (amphibole)	0.052	mm2
Area Examined (chrysotile)	0.052	mm2

Magnification: LOW

Recording Rules:	Min AR	Min length (um)	Min width (um)
	3:1	5	0.25

Stopping Rules:	Target Sens.	Max AE (mm^2)	Max N LA
	0.033	0.500	25

COUNTS (based on countable structures only)

Bin	LA	OA	CH	All Asbestos
Total				
PCME	0	0	0	0

CONCENTRATION (s/cc)

Bin	LA	OA	CH	All Asbestos
Total				
PCME	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Total: Length > 0.5 um, Aspect Ratio >= 3:1
PCME: Length > 5 um, Width >= 0.25 um, Aspect Ratio >= 3:1

Chi-sq test for filter loading --
p value: 1.0E+00
interpretation: OK

230617JK02_AC-00013_041718445-0004_TEM-ISO_AR_06-28-17_D_NotQC_C0.xlsm

LIBBY

Version Air-DustEDD_38n

TEM Asbestos Structure Count -- ISO 10312

EPA Sample Number	AC-00013
Tag	AL1
Status	ANALYZED
Lab QC Type	NOT QC
Lab Sample Number	041718445-0004
Matrix	Air
Category	Field
Prep	Direct
Analysis Method	TEM-ISO
Est. Particulate Loading	3%

PARAMETERS		
Effective filter area	385.0	mm2
F factor	1.00E+00	
Number of Grid Openings (amphibole)	4	
Number of Grid Openings (chrysotile)	4	
Grid opening area	0.013	mm2
Volume (L) or Area (cm2)	531	L
Sensitivity (amphibole)	1.38E-02	s/cc
Sensitivity (chrysotile)	1.38E-02	s/cc
Area Examined (amphibole)	0.052	mm2
Area Examined (chrysotile)	0.052	mm2

Magnification: LOW

Recording Rules:	Min AR	Min length (um)	Min width (um)
	3:1	5	0.25

Stopping Rules:	Target Sens.	Max AE (mm^2)	Max N LA
	0.033	0.500	25

COUNTS (based on countable structures only)

Bin	LA	OA	CH	All Asbestos
Total				
PCME	1	0	0	1

CONCENTRATION (s/cc)

Bin	LA	OA	CH	All Asbestos
Total				
PCME	1.38E-02	0.00E+00	0.00E+00	1.38E-02

Total: Length > 0.5 um, Aspect Ratio >= 3:1
PCME: Length > 5 um, Width >= 0.25 um, Aspect Ratio >= 3:1

Chi-sq test for filter loading --
p value: 3.9E-01
interpretation: OK

230617JK02_AC-00015_041718445-0006_TEM-ISO_AR_06-28-17_D_NotQC_C0.xlsm
Version Air-DustEDD_38n

LIBBY
TEM Asbestos Structure Count -- ISO 10312

EPA Sample Number	AC-00015
Tag	AL1
Status	ANALYZED
Lab QC Type	NOT QC
Lab Sample Number	041718445-0006
Matrix	Air
Category	Field
Prep	Direct
Analysis Method	TEM-ISO
Est. Particulate Loading	5%

PARAMETERS		
Effective filter area	385.0	mm2
F factor	1.00E+00	
Number of Grid Openings (amphibole)	4	
Number of Grid Openings (chrysotile)	4	
Grid opening area	0.013	mm2
Volume (L) or Area (cm2)	540	L
Sensitivity (amphibole)	1.36E-02	s/cc
Sensitivity (chrysotile)	1.36E-02	s/cc
Area Examined (amphibole)	0.052	mm2
Area Examined (chrysotile)	0.052	mm2

Magnification: LOW

Recording Rules:

Min AR	Min length (um)	Min width (um)
3:1	5	0.25

Stopping Rules:

Target Sens.	Max AE (mm^2)	Max N LA
0.033	0.500	25

COUNTS (based on countable structures only)

Bin	LA	OA	CH	All Asbestos
Total				
PCME	1	0	0	1

CONCENTRATION (s/cc)

Bin	LA	OA	CH	All Asbestos
Total				
PCME	1.36E-02	0.00E+00	0.00E+00	1.36E-02

Total: Length > 0.5 um, Aspect Ratio >= 3:1
PCME: Length > 5 um, Width >= 0.25 um, Aspect Ratio >= 3:1

Chi-sq test for filter loading --
p value: 3.9E-01
interpretation: OK

230617JK02_AC-00017_041718445-0008_TEM-ISO_AR_06-28-17_D_NotQC_C0.xlsm

LIBBY Version Air-DustEDD_38n

TEM Asbestos Structure Count -- ISO 10312

EPA Sample Number	AC-00017
Tag	AL1
Status	ANALYZED
Lab QC Type	NOT QC
Lab Sample Number	041718445-0008
Matrix	Air
Category	Field
Prep	Direct
Analysis Method	TEM-ISO
Est. Particulate Loading	5%

PARAMETERS		
Effective filter area	385.0	mm2
F factor	1.00E+00	
Number of Grid Openings (amphibole)	4	
Number of Grid Openings (chrysotile)	4	
Grid opening area	0.013	mm2
Volume (L) or Area (cm2)	536	L
Sensitivity (amphibole)	1.39E-02	s/cc
Sensitivity (chrysotile)	1.39E-02	s/cc
Area Examined (amphibole)	0.052	mm2
Area Examined (chrysotile)	0.052	mm2

Magnification: LOW

Recording Rules:	Min AR	Min length (um)	Min width (um)
	3:1	5	0.25

Stopping Rules:	Target Sens.	Max AE (mm^2)	Max N LA
	0.033	0.500	25

COUNTS (based on countable structures only)

Bin	LA	OA	CH	All Asbestos
Total				
PCME	0	0	0	0

CONCENTRATION (s/cc)

Bin	LA	OA	CH	All Asbestos
Total				
PCME	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Total: Length > 0.5 um, Aspect Ratio >= 3:1

PCME: Length > 5 um, Width >= 0.25 um, Aspect Ratio >= 3:1

Chi-sq test for filter loading --

p value: 1.0E+00

interpretation: OK

230617JK02_AC-00015_041718445-0006_TEM-ISO_AR_06-28-17_D_RD_C0.xlsm
Version Air-DustEDD_38n

LIBBY
TEM Asbestos Structure Count -- ISO 10312

EPA Sample Number	AC-00015
Tag	AL1
Status	ANALYZED
Lab QC Type	Recount Different
Lab Sample Number	041718445-0006
Matrix	Air
Category	Field
Prep	Direct
Analysis Method	TEM-ISO
Est. Particulate Loading	5%

PARAMETERS		
Effective filter area	385.0	mm2
F factor	1.00E+00	
Number of Grid Openings (amphibole)	4	
Number of Grid Openings (chrysotile)	4	
Grid opening area	0.013	mm2
Volume (L) or Area (cm2)	540	L
Sensitivity (amphibole)	1.36E-02	s/cc
Sensitivity (chrysotile)	1.36E-02	s/cc
Area Examined (amphibole)	0.052	mm2
Area Examined (chrysotile)	0.052	mm2

Magnification: LOW

Recording Rules:

Min AR	Min length (um)	Min width (um)
3:1	5	0.25

Stopping Rules:

Target Sens.	Max AE (mm^2)	Max N LA
0.033	0.500	25

COUNTS (based on countable structures only)

Bin	LA	OA	CH	All Asbestos
Total				
PCME	1	0	0	1

CONCENTRATION (s/cc)

Bin	LA	OA	CH	All Asbestos
Total				
PCME	1.36E-02	0.00E+00	0.00E+00	1.36E-02

Total: Length > 0.5 um, Aspect Ratio >= 3:1
PCME: Length > 5 um, Width >= 0.25 um, Aspect Ratio >= 3:1

Chi-sq test for filter loading --
p value: 3.9E-01
interpretation: OK

APTIM Federal Services, LLC
QATS Program
2700 Chandler Avenue
Las Vegas, Nevada 89120

November 3, 2017

David Berry
USEPA Region 8
1595 Wynkoop Street (8EPR-SR)
Denver, CO 80202-1129

Document ID #: 1021-11032017-1

Dear Mr. Berry:

EPA CONTRACT NUMBER EP-W-16-016
TASK ORDER NUMBER 1021
QA SUPPORT FOR RI/FS AT THE LIBBY ASBESTOS SITE OU3

Enclosed please find the Release of Validated Data Report for the validation of Transmission Electron Microscopy (TEM) ISO 10312 air sample data, Laboratory Job Number 041728459. The five (5) air samples associated with these data were analyzed by EMSL Analytical, Inc. in Cinnaminson, NJ for the Libby OU3 2017 Cover Study. This report and accompanying appendices are deliverables under Task 07 of the subject Task Order.

If you have any questions, please feel free to contact me.

Sincerely,

Lyndsay K. Gensler
Task Leader, QATS Program
Phone: 702-895-8730
E-Mail Address: lyndsay.gensler@aptim.com
APTIM Federal Services, LLC

cc: QATS Task Order Contract Officer Representative (EPA ASB)
Administrative Contracting Officer (letter only)

APTIM

RELEASE OF VALIDATED DATA

DATE: 11/03/2017

SUBJECT: Review of Data for Laboratory Job Number: 041728459

LABORATORY: EMSL Analytical, Inc., Cinnaminson, NJ

FROM: Quality Assurance Technical Support (QATS) Program, Las Vegas, NV
APTIM Federal Services, LLC

TO: David Berry, Environmental Protection Agency

QATS personnel reviewed the data for the following case:

Applicable SAP:	COVEROU3-0917, Revision 1
Chain-of-Custody Number:	240917CL01
Method:	Transmission Electron Microscopy (TEM) ISO 10312
Applicable Laboratory Modification(s):	LB-000016, LB-000029, LB-000066, LB-000067, LB-000085, and LB-000091
Number and Type of Samples:	5 Air Samples
EPA Sample Numbers:	CV-00038, CV-00040, CV-00042, CV-00044, CV-00046

VALIDATION SUMMARY

Five (5) air samples from Laboratory Job Number 041728459, were collected on 09/23/2017 and shipped to EMSL Analytical, Inc. in Cinnaminson, NJ for TEM analysis by ISO 10312. The samples were received at the laboratory intact on 09/29/2017, and were analyzed between 09/30/2017 and 10/03/2017.

Listed below are the Data Qualification Summary Table, EDD/Bench Sheet Discrepancy Table, Data Qualifier Table, and Reason Code Table. Note that no data from this data set were qualified.

DATA QUALIFICATION SUMMARY TABLE

Criteria Exceeded	EPA Sample ID	Validation Qualifier	Reason Code
None.			

EDD/BENCH SHEET DISCREPANCY TABLE

EPA Sample ID	C# *	Method/Matrix	Lab. Job No.	Analysis Date	Discrepancy
None.					

'*' The EDD correction number in column 2. (i.e., C0, C1, C2, etc..)

DATA QUALIFIER TABLE

Qualifier	Definition
J	The result is estimated. The associated numerical value is an approximation.
UJ	The non-detect result may be inaccurate or imprecise due to the quality of the data generated because certain QC criteria were not met.
R	The sample results are rejected due to serious deficiencies.
X	Validator defined.

TEM REASON CODE TABLE

Reason Code	Definition
MC	Structure/fiber counts and recorded structure dimensions may be inaccurate due to improper or infrequent scope alignment and/or magnification calibrations.
IC	Identification by elemental composition or diffraction pattern may be inaccurate due to improper or infrequent EDXA or camera constant calibration.
PA	Structure/fiber counts and reported concentrations may be inaccurate due to improper or infrequent calibration of the plasma asher.
SC	The reported concentration may be inaccurate due to the condition of samples upon receipt at the laboratory.
DL	The area analyzed, structures counted, or AS do not meet the requirements specified in the applicable SAP Analytical Summary.
ID	The asbestos identification and concentrations may be inaccurate because the recorded structure types are not consistent with those described in the applicable TEM Method and/or laboratory modification(s).

VALIDATION PROCESS

The samples for Laboratory Job Number 041728459 were collected from the subject site on 09/23/2017. All samples were prepared and analyzed in accordance with TEM ISO 10312 and SAP COVEROU300917, Rev. 1. The Quality Assurance Technical Support (QATS) Program performed validation and a transcription check in accordance with Libby-specific data validation SOPs. Preparation of this report was performed under Technical Direction 02, Task 07, of Task Order 1021.

The sample results on bench sheets and other supporting documents provided in the hardcopy deliverables were compared to the entries in the associated laboratory method-specific EDDs to ensure that the reported results are complete, compliant with the specified methodology, and accurate. Additional support information provided in this data validation report include the QATS Data Review Checklist used to document the data validation process (see Appendix A); and the sample results as reported by the laboratory, with qualifiers as applicable (see Appendix B).

TEM VALIDATION SUMMARY

1. **DATA PACKAGE INVENTORY AND SAMPLE RECEIPT:** The data package included a narrative, Chain-of-Custody (COC) record, EDD files, raw data (bench sheets), and QC samples. The samples were properly packaged, sealed, undamaged, and labeled upon receipt at the laboratory. The COC record was reviewed and found to be acceptable.

2. **SAMPLE PREPARATION:** The appropriate preparation documents were provided.

3. **EQUIPMENT CALIBRATION AND PERFORMANCE CHECKS (i.e., daily microscope alignment, screen magnification, EDS calibration, and sensitivity checks):** The equipment alignment and calibration documentation provided separately were performed at the correct frequency, indicating that the instruments were in proper working order during the time of sample analyses.

4. **ANALYTICAL SENSITIVITY:** A sufficient number of grid openings have been analyzed to achieve the required analytical sensitivity and/or the appropriate stopping rule was invoked.

5. **STRUCTURE RECORDING AND ASBESTOS IDENTIFICATION:** The structure recording and asbestos identification were found to be acceptable.

6. **BLANK ANALYSIS:** One laboratory blank was analyzed and reported with this sample set. There were no structures recorded. Note: Blanks are reviewed and evaluated on a program-wide basis. Qualification for blank contamination is generally not applied during the validation process.

7. **ANALYTICAL VARIABILITY:** The laboratory did not perform any quality control (QC) sample analyses with this sample set. Note: QC samples are reviewed and evaluated on a program-wide basis. Qualification for discordant results is not applied during the validation process.

8. **LABORATORY MODIFICATIONS:** Laboratory Modification(s) LB-000016, LB-000029, LB-000066, LB-000067, LB-000085, and LB-000091 were associated with this sample set.

9. **OVERALL ASSESSMENT OF DATA:** The deliverable was found to be complete and accurate. No qualification of the data is necessary.

REVIEWED BY: Michael Lenkauskas DATE: 10/26/2017

Appendix A

Data Review Checklist

Data Review Checklist for the Validation of Libby Transmission Electron Microscopy (TEM) Data Deliverables

Project Name: Libby OU3 2017 Cover Study	**Laboratory Job No: 041728459**
Number of Samples/Matrix: 5 Air Samples	**Laboratory: EMSL Analytical, Inc., Cinnaminson, NJ**
TEM Method/SOP: TEM ISO 10312	**SAP Number: COVEROU3-0917, Revision 1**
Laboratory Modifications: LB-000016, LB-000029, LB-000066, LB-000067, LB-000085, LB-000091	

1.0 Data Package Inventory	**Yes**	**No**	**Comments**
1.1 Were the project-specific requirements provided in the SAP Analytical Summary submitted with the data package?	☒	☐	SAP/QAPP COVEROU3-0917, Rev. 1 is included in the data package.
1.2 Did the received hard copy deliverables contain all the necessary components:			
1.2.1 Narrative?	☒	☐	
1.2.2 Chain-of-Custody?	☒	☐	
1.2.3 EDD file?	☒	☐	
1.2.4 Raw Data - Bench Sheets?	☒	☐	
1.2.5 QC Sample Data:			
1.2.5.1 Blank(s)?	☒	☐	One laboratory blank (LB).
1.2.5.2 Recount Same (RS)?	☐	☒	
1.2.5.3 Recount Different (RD)?	☐	☒	
1.2.5.4 Verified Analysis (VA)?	☐	☒	
1.2.5.5 Repreparation (RP)?	☐	☒	
1.2.6 Calibration Data (submitted quarterly)?	☒	☐	
1.2.7 Communication Records?	☐	☒	
1.2.8 Miscellaneous?	☐	☒	
2.0 Chain-of-Custody Information			
2.1 Was the following information recorded in the hard copy electronic deliverables (if applicable) and is it consistent with the information recorded on the COC:			
2.1.1 COC Number?	☒	☐	COC #240917CL01
2.1.2 Case or Sample Set Number?	☒	☐	
2.1.3 EPA Sample ID?	☒	☐	
2.1.4 Date/Time Collected?	☒	☐	
2.1.5 Sample Volume?	☒	☐	
2.1.6 Sample Matrix?	☒	☐	
2.1.7 Analyses (Method)?	☒	☐	
2.1.8 Date/Time Received?	☒	☐	
2.1.9 Other (describe)?	☐	☐	NA
2.2 Were the COC records signed and dated upon receipt?	☒	☐	

Additional Comments:

Data Review Checklist for the Validation of Libby Transmission Electron Microscopy (TEM) Data Deliverables

3.0 Sample Result Validation	Yes	No	Comments
3.1 Is the sample preparation method documented and final sample volume recorded?	☒	☐	
3.2 Were the correct number of grid openings used to achieve the specified analytical sensitivity and/or were associated stopping rules invoked?	☒	☐	
3.3 Verify that the following information from the laboratory's bench sheets have been transcribed correctly:			
3.3.1.1 Grid identification?	☒	☐	
3.3.1.2 Grid opening?	☒	☐	
3.3.1.3 Structure type?	☒	☐	
3.3.1.4 Number of primary and secondary structures?	☒	☐	
3.3.1.5 Length and width dimensions?	☒	☐	
3.3.1.6 Structure identification?	☒	☐	
3.3.1.7 Mineral type?	☒	☐	
3.4 Are overloaded samples correctly reported to the specified percent obscuration (i.e. 10%, 25%)?	☐	☒	No samples determined to be overloaded.
3.5 If overloading or uneven loading occurs, or the filters contain loose debris, are samples prepared by an alternate method (i.e. indirect preparation)?	☐	☐	NA
3.6 Verify that the following information is documented correctly:			
3.6.1 Magnification?	☒	☐	
3.6.2 Field or QC sample type?	☒	☐	
3.6.3 Number of grids prepared?	☒	☐	
3.6.4 Filter area in (mm^2)?	☒	☐	
3.6.5 Analysis/preparation date?	☒	☐	
3.7 Verify the totals reported on the count sheets for the various types of structures are correct.	☒	☐	.
3.8 Are the required spectra included for all hits reported (i.e. ED, EDXA, SAED)?	☒	☐	

Additional Comments:

Data Review Checklist for the Validation of Libby Transmission Electron Microscopy (TEM) Data Deliverables

4.0 Quality Control Validation	Yes	No	Comments
4.1 Blanks (if applicable)			
4.1.1 Are laboratory blanks (direct, indirect) prepared, analyzed and reported with the sample set?	☒	☐	One LB was performed. No structures were found.
4.1.2 Are any structures observed in the blanks?	☐	☒	
Note: Laboratory Blanks are also reviewed and evaluated on a program wide basis. Qualification is generally not applied during the validation process; however, the field blanks reported with the sample set can be directly associated with the samples in the sample set and qualification may apply.			
4.2 Recount Same (RS)			
4.2.1 Are recounts same (same analyst on the same grids and grid openings) sample analyses performed and reported with the sample set?	☐	☒	
4.3 Recount Different (RD)			
4.3.1 Are recounts different (different analyst on the same grids and grid openings) sample analyses performed and reported with the sample set?	☐	☒	
4.4 Verified Analyses (VA)			
4.4.1 Are verified analyses (second analysis on same grids and grid openings) performed and reported with the sample set?	☐	☒	
4.5 Repreparation (RP)			
4.5.1 Are repreparation analyses (different analyst on reprepared grids and grid openings) performed and reported with the sample set?	☐	☒	
Note: RS, RD, VA, and RP analyses are reviewed and evaluated on a program wide basis. Qualification is not applied during the validation process; however, the QC samples reported with the sample set are listed in the validation report.			

Additional Comments:

Data Review Checklist for the Validation of Libby Transmission Electron Microscopy (TEM) Data Deliverables

5.0 Calibration & Microscope Alignment Validation	Yes	No	Comments
5.1 Is evidence of the calibration of TEM Screen Magnification provided for all sample analyses?	☒	☐	
5.1.1 Daily Alignment and Cu/Al Calibration?	☒	☐	
5.1.2 Camera Constant Calibration?	☒	☐	
5.1.3 k-Factors?	☒	☐	
5.1.4 Plasma Asher?	☒	☐	
5.2 Are the calibration checks listed above performed at the required frequencies?	☒	☐	
5.3 Are the calibration checks within the specified criteria?	☒	☐	
5.4 Are all calibration checks traceable to the associated samples analyses?	☒	☐	
5.5 If required, are the following additional system checks provided:			
5.5.1 Beam Dose Check?	☒	☐	
5.5.2 Spot Size Check?	☒	☐	
5.5.3 Detector Resolution Check?	☒	☐	
5.5.4 If "no" then qualify the associated results in accordance with the Microscope Alignment and Instrument/Standard Calibration tables in SOP QATS-70-095.			
6.0 Case Narrative Validation			
6.1 Does the data package narrative include descriptions of the following:			
6.1.1 Samples received (matrix/method)?	☒	☐	
6.1.2 Method/Laboratory Modifications?	☒	☐	
6.1.3 Example sample calculation?	☐	☒	
6.1.4 Laboratory blank contamination?	☐	☒	
6.1.5 Quality control analyses outside specified criteria?	☐	☒	
6.1.6 Any problems encountered and subsequent corrective action?	☐	☒	

Additional Comments:

Validated By: Michael Lenkauskas **Date** 10/26/2017

QA Review: Lyndsay Gensler **Date** 11/01/2017

Appendix B

Qualified Result Forms

240917CL01_CV-00038_041728459-0001_TEM-ISO_AR_10-02-17_D_NotQC_C0.xlsm
Version Air-DustEDD_38n

LIBBY

TEM Asbestos Structure Count -- ISO 10312

EPA Sample Number	CV-00038
Tag	AL1
Status	ANALYZED
Lab QC Type	NOT QC
Lab Sample Number	041728459-0001
Matrix	Air
Category	Field
Prep	Direct
Analysis Method	TEM-ISO
Est. Particulate Loading	1%

PARAMETERS		
Effective filter area	385.0	mm2
F factor	1.00E+00	
Number of Grid Openings (amphibole)	46	
Number of Grid Openings (chrysotile)	46	
Grid opening area	0.013	mm2
Volume (L) or Area (cm2)	60	L
Sensitivity (amphibole)	1.08E-02	s/cc
Sensitivity (chrysotile)	1.08E-02	s/cc
Area Examined (amphibole)	0.593	mm2
Area Examined (chrysotile)	0.593	mm2

Magnification: LOW

Recording Rules:	Min AR	Min length (um)	Min width (um)
	3:1	5	0.25

Stopping Rules:	Target Sens.	Max AE (mm^2)	Max N LA
	0.011	1.670	25

COUNTS (based on countable structures only)

Bin	LA	OA	CH	All Asbestos
Total				
PCME	4	0	0	4

CONCENTRATION (s/cc)

Bin	LA	OA	CH	All Asbestos
Total				
PCME	4.33E-02	0.00E+00	0.00E+00	4.33E-02

Total: Length > 0.5 um, Aspect Ratio >= 3:1
PCME: Length > 5 um, Width >= 0.25 um, Aspect Ratio >= 3:1

Chi-sq test for filter loading --
p value: 2.7E-02
interpretation: OK

240917CL01_CV-00040_041728459-0003_TEM-ISO_AR_10-02-17_D_NotQC_C0.xlsm
Version Air-DustEDD_38n

LIBBY

TEM Asbestos Structure Count -- ISO 10312

EPA Sample Number	CV-00040
Tag	AL1
Status	ANALYZED
Lab QC Type	NOT QC
Lab Sample Number	041728459-0003
Matrix	Air
Category	Field
Prep	Direct
Analysis Method	TEM-ISO
Est. Particulate Loading	1%

PARAMETERS		
Effective filter area	385.0	mm2
F factor	1.00E+00	
Number of Grid Openings (amphibole)	46	
Number of Grid Openings (chrysotile)	46	
Grid opening area	0.013	mm2
Volume (L) or Area (cm2)	60	L
Sensitivity (amphibole)	1.08E-02	s/cc
Sensitivity (chrysotile)	1.08E-02	s/cc
Area Examined (amphibole)	0.593	mm2
Area Examined (chrysotile)	0.593	mm2

Magnification: LOW

Recording Rules:	Min AR	Min length (um)	Min width (um)
	3:1	5	0.25

Stopping Rules:	Target Sens.	Max AE (mm^2)	Max N LA
	0.011	1.670	25

COUNTS (based on countable structures only)

Bin	LA	OA	CH	All Asbestos
Total				
PCME	1	0	0	1

CONCENTRATION (s/cc)

Bin	LA	OA	CH	All Asbestos
Total				
PCME	1.08E-02	0.00E+00	0.00E+00	1.08E-02

Total: Length > 0.5 um, Aspect Ratio >= 3:1
PCME: Length > 5 um, Width >= 0.25 um, Aspect Ratio >= 3:1

Chi-sq test for filter loading --
p value: 4.7E-01
interpretation: OK

240917CL01_CV-00042_041728459-0005_TEM-ISO_AR_10-03-17_D_NotQC_C0.xlsm

LIBBY Version Air-DustEDD_38n

TEM Asbestos Structure Count -- ISO 10312

EPA Sample Number	CV-00042
Tag	AL1
Status	ANALYZED
Lab QC Type	NOT QC
Lab Sample Number	041728459-0005
Matrix	Air
Category	Field
Prep	Direct
Analysis Method	TEM-ISO
Est. Particulate Loading	1%

PARAMETERS		
Effective filter area	385.0	mm2
F factor	1.00E+00	
Number of Grid Openings (amphibole)	46	
Number of Grid Openings (chrysotile)	46	
Grid opening area	0.013	mm2
Volume (L) or Area (cm2)	60	L
Sensitivity (amphibole)	1.08E-02	s/cc
Sensitivity (chrysotile)	1.08E-02	s/cc
Area Examined (amphibole)	0.593	mm2
Area Examined (chrysotile)	0.593	mm2

Magnification: LOW

Recording Rules:	Min AR	Min length (um)	Min width (um)
	3:1	5	0.25

Stopping Rules:	Target Sens.	Max AE (mm^2)	Max N LA
	0.011	1.670	25

COUNTS (based on countable structures only)

Bin	LA	OA	CH	All Asbestos
Total				
PCME	1	0	0	1

CONCENTRATION (s/cc)

Bin	LA	OA	CH	All Asbestos
Total				
PCME	1.08E-02	0.00E+00	0.00E+00	1.08E-02

Total: Length > 0.5 um, Aspect Ratio >= 3:1
PCME: Length > 5 um, Width >= 0.25 um, Aspect Ratio >= 3:1

Chi-sq test for filter loading --
p value: 4.7E-01
interpretation: OK

240917CL01_CV-00044_041728459-0007_TEM-ISO_AR_10-03-17_D_NotQC_C0.xlsm
Version Air-DustEDD_38n

LIBBY

TEM Asbestos Structure Count -- ISO 10312

EPA Sample Number	CV-00044
Tag	AL1
Status	ANALYZED
Lab QC Type	NOT QC
Lab Sample Number	041728459-0007
Matrix	Air
Category	Field
Prep	Direct
Analysis Method	TEM-ISO
Est. Particulate Loading	1%

PARAMETERS		
Effective filter area	385.0	mm2
F factor	1.00E+00	
Number of Grid Openings (amphibole)	46	
Number of Grid Openings (chrysotile)	46	
Grid opening area	0.013	mm2
Volume (L) or Area (cm2)	60	L
Sensitivity (amphibole)	1.08E-02	s/cc
Sensitivity (chrysotile)	1.08E-02	s/cc
Area Examined (amphibole)	0.593	mm2
Area Examined (chrysotile)	0.593	mm2

Magnification: LOW

Recording Rules:	Min AR	Min length (um)	Min width (um)
	3:1	5	0.25

Stopping Rules:	Target Sens.	Max AE (mm^2)	Max N LA
	0.011	1.670	25

COUNTS (based on countable structures only)

Bin	LA	OA	CH	All Asbestos
Total				
PCME	4	1	0	5

CONCENTRATION (s/cc)

Bin	LA	OA	CH	All Asbestos
Total				
PCME	4.33E-02	1.08E-02	0.00E+00	5.41E-02

Total: Length > 0.5 um, Aspect Ratio >= 3:1
PCME: Length > 5 um, Width >= 0.25 um, Aspect Ratio >= 3:1

Chi-sq test for filter loading --
p value: 2.7E-02
interpretation: OK

240917CL01_CV-00046_041728459-0009_TEM-ISO_AR_09-30-17_D_NotQC_C0.xlsm
Version Air-DustEDD_38n

LIBBY

TEM Asbestos Structure Count -- ISO 10312

EPA Sample Number	CV-00046
Tag	AL1
Status	ANALYZED
Lab QC Type	NOT QC
Lab Sample Number	041728459-0009
Matrix	Air
Category	Field
Prep	Direct
Analysis Method	TEM-ISO
Est. Particulate Loading	1%

PARAMETERS		
Effective filter area	385.0	mm2
F factor	1.00E+00	
Number of Grid Openings (amphibole)	46	
Number of Grid Openings (chrysotile)	46	
Grid opening area	0.013	mm2
Volume (L) or Area (cm2)	60	L
Sensitivity (amphibole)	1.08E-02	s/cc
Sensitivity (chrysotile)	1.08E-02	s/cc
Area Examined (amphibole)	0.593	mm2
Area Examined (chrysotile)	0.593	mm2

Magnification: LOW

Recording Rules:	Min AR	Min length (um)	Min width (um)
	3:1	5	0.25

Stopping Rules:	Target Sens.	Max AE (mm^2)	Max N LA
	0.011	1.670	25

COUNTS (based on countable structures only)

Bin	LA	OA	CH	All Asbestos
Total				
PCME	5	0	0	5

CONCENTRATION (s/cc)

Bin	LA	OA	CH	All Asbestos
Total				
PCME	5.41E-02	0.00E+00	0.00E+00	5.41E-02

Total: Length > 0.5 um, Aspect Ratio >= 3:1
PCME: Length > 5 um, Width >= 0.25 um, Aspect Ratio >= 3:1

Chi-sq test for filter loading --
p value: 6.4E-01
interpretation: OK

APTIM Federal Services, LLC
QATS Program
2700 Chandler Avenue
Las Vegas, Nevada 89120

November 3, 2017

David Berry
USEPA Region 8
1595 Wynkoop Street (8EPR-SR)
Denver, CO 80202-1129

Document ID #: 1021-11032017-2

Dear Mr. Berry:

EPA CONTRACT NUMBER EP-W-16-016
TASK ORDER NUMBER 1021
QA SUPPORT FOR RI/FS AT THE LIBBY ASBESTOS SITE OU3

Enclosed please find the Release of Validated Data Report for the validation of Transmission Electron Microscopy (TEM) ISO 10312 air sample data, Laboratory Job Number 321723073. The five (5) air samples associated with these data were analyzed by EMSL Analytical, Inc. in Pasadena, CA for the Libby OU3 2017 Cover Study. This report and accompanying appendices are deliverables under Task 07 of the subject Task Order.

If you have any questions, please feel free to contact me.

Sincerely,

Lyndsay K. Gensler
Task Leader, QATS Program
Phone: 702-895-8730
E-Mail Address: lyndsay.gensler@aptim.com
APTIM Federal Services, LLC

cc: QATS Task Order Contract Officer Representative (EPA ASB)
Administrative Contracting Officer (letter only)

RELEASE OF VALIDATED DATA

DATE: 11/03/2017

SUBJECT: Review of Data for Laboratory Job Number: 321723073

LABORATORY: EMSL Analytical, Inc., Pasadena, CA

FROM: Quality Assurance Technical Support (QATS) Program, Las Vegas, NV
APTIM Federal Services, LLC

TO: David Berry, Environmental Protection Agency

QATS personnel reviewed the data for the following case:

Applicable SAP: COVEROU3-0917, Revision 1

Chain-of-Custody Number: 240917JR01

Method: Transmission Electron Microscopy (TEM) ISO 10312

Applicable Laboratory Modification(s): LB-000016, LB-000029, LB-000066, LB-000067, LB-000085, and LB-000091

Number and Type of Samples: 5 Air Samples

EPA Sample Numbers: CV-00048, CV-00050, CV-00052, CV-00054, CV-00056

VALIDATION SUMMARY

Five (5) air samples from Laboratory Job Number 321723073, were collected on 09/23/2017 and shipped to EMSL Analytical, Inc. in Pasadena, CA for TEM analysis by ISO 10312. The samples were received at the laboratory intact on 09/29/2017, and were analyzed between 10/03/2017 and 10/16/2017.

Listed below are the Data Qualification Summary Table, EDD/Bench Sheet Discrepancy Table, Data Qualifier Table, and Reason Code Table. Note that no data from this data set were qualified.

DATA QUALIFICATION SUMMARY TABLE

Criteria Exceeded	EPA Sample ID	Validation Qualifier	Reason Code
None.			

EDD/BENCH SHEET DISCREPANCY TABLE

EPA Sample ID	C# *	Method/Matrix	Lab. Job No.	Analysis Date	Discrepancy
None.					

'*' The EDD correction number in column 2. (i.e., C0, C1, C2, etc..)

DATA QUALIFIER TABLE

Qualifier	Definition
J	The result is estimated. The associated numerical value is an approximation.
UJ	The non-detect result may be inaccurate or imprecise due to the quality of the data generated because certain QC criteria were not met.
R	The sample results are rejected due to serious deficiencies.
X	Validator defined.

TEM REASON CODE TABLE

Reason Code	Definition
MC	Structure/fiber counts and recorded structure dimensions may be inaccurate due to improper or infrequent scope alignment and/or magnification calibrations.
IC	Identification by elemental composition or diffraction pattern may be inaccurate due to improper or infrequent EDXA or camera constant calibration.
PA	Structure/fiber counts and reported concentrations may be inaccurate due to improper or infrequent calibration of the plasma asher.
SC	The reported concentration may be inaccurate due to the condition of samples upon receipt at the laboratory.
DL	The area analyzed, structures counted, or AS do not meet the requirements specified in the applicable SAP Analytical Summary.
ID	The asbestos identification and concentrations may be inaccurate because the recorded structure types are not consistent with those described in the applicable TEM Method and/or laboratory modification(s).

VALIDATION PROCESS

The samples for Laboratory Job Number 321723073 were collected from the subject site on 09/23/2017. All samples were prepared and analyzed in accordance with TEM ISO 10312 and SAP COVEROU300917, Rev. 1. The Quality Assurance Technical Support (QATS) Program performed validation and a transcription check in accordance with Libby-specific data validation SOPs. Preparation of this report was performed under Technical Direction 02, Task 07, of Task Order 1021.

The sample results on bench sheets and other supporting documents provided in the hardcopy deliverables were compared to the entries in the associated laboratory method-specific EDDs to ensure that the reported results are complete, compliant with the specified methodology, and accurate. Additional support information provided in this data validation report include the QATS Data Review Checklist used to document the data validation process (see Appendix A); and the sample results as reported by the laboratory, with qualifiers as applicable (see Appendix B).

TEM VALIDATION SUMMARY

1. **DATA PACKAGE INVENTORY AND SAMPLE RECEIPT:** The data package included a narrative, Chain-of-Custody (COC) record, EDD files, raw data (bench sheets), and QC samples. The samples were properly packaged, sealed, undamaged, and labeled upon receipt at the laboratory. The COC record was reviewed and found to be acceptable. Note that, as indicated in the data package, a revised COC was received by the laboratory via email on 10/13/2017 and included in the data package.

2. **SAMPLE PREPARATION:** The appropriate preparation documents were provided.

3. **EQUIPMENT CALIBRATION AND PERFORMANCE CHECKS (i.e., daily microscope alignment, screen magnification, EDS calibration, and sensitivity checks):** The equipment alignment and calibration documentation provided separately were performed at the correct frequency, indicating that the instruments were in proper working order during the time of sample analyses.

4. **ANALYTICAL SENSITIVITY:** A sufficient number of grid openings have been analyzed to achieve the required analytical sensitivity and/or the appropriate stopping rule was invoked.

5. **STRUCTURE RECORDING AND ASBESTOS IDENTIFICATION:** The structure recording and asbestos identification were found to be acceptable.

6. **BLANK ANALYSIS:** One laboratory blank was analyzed and reported with this sample set. There were no structures recorded. Note: Blanks are reviewed and evaluated on a program-wide basis. Qualification for blank contamination is generally not applied during the validation process.

7. **ANALYTICAL VARIABILITY:** The laboratory did not perform any quality control (QC) sample analyses with this sample set. Note: QC samples are reviewed and evaluated on a program-wide basis. Qualification for discordant results is not applied during the validation process.

8. **LABORATORY MODIFICATIONS:** Laboratory Modification(s) LB-000016, LB-000029, LB-000066, LB-000067, LB-000085, and LB-000091 were associated with this sample set.

9. **OVERALL ASSESSMENT OF DATA:** The deliverable was found to be complete and accurate. No qualification of the data is necessary.

REVIEWED BY: Michael Lenkauskas DATE: 10/26/2017

Appendix A

Data Review Checklist

Data Review Checklist for the Validation of Libby Transmission Electron Microscopy (TEM) Data Deliverables

Project Name: Libby OU3 2017 Cover Study	**Laboratory Job No: 321723073**
Number of Samples/Matrix: 5 Air Samples	**Laboratory: EMSL Analytical, Inc., Pasadena, CA**
TEM Method/SOP: TEM ISO 10312	**SAP Number: COVEROU3-0917, Revision 1**
Laboratory Modifications: LB-000016, LB-000029, LB-000066, LB-000067, LB-000085, LB-000091	

1.0 Data Package Inventory	**Yes**	**No**	**Comments**
1.1 Were the project-specific requirements provided in the SAP Analytical Summary submitted with the data package?	☒	☐	SAP/QAPP COVEROU3-0917, Rev. 1 is included in the data package.
1.2 Did the received hard copy deliverables contain all the necessary components:			
1.2.1 Narrative?	☒	☐	
1.2.2 Chain-of-Custody?	☒	☐	
1.2.3 EDD file?	☒	☐	
1.2.4 Raw Data - Bench Sheets?	☒	☐	
1.2.5 QC Sample Data:			
1.2.5.1 Blank(s)?	☒	☐	One laboratory blank (LB).
1.2.5.2 Recount Same (RS)?	☐	☒	
1.2.5.3 Recount Different (RD)?	☐	☒	
1.2.5.4 Verified Analysis (VA)?	☐	☒	
1.2.5.5 Repreparation (RP)?	☐	☒	
1.2.6 Calibration Data (submitted quarterly)?	☒	☐	
1.2.7 Communication Records?	☐	☒	
1.2.8 Miscellaneous?	☐	☒	
2.0 Chain-of-Custody Information			
2.1 Was the following information recorded in the hard copy electronic deliverables (if applicable) and is it consistent with the information recorded on the COC:			
2.1.1 COC Number?	☒	☐	COC #240917JR01
2.1.2 Case or Sample Set Number?	☒	☐	
2.1.3 EPA Sample ID?	☒	☐	
2.1.4 Date/Time Collected?	☒	☐	
2.1.5 Sample Volume?	☒	☐	
2.1.6 Sample Matrix?	☒	☐	
2.1.7 Analyses (Method)?	☒	☐	
2.1.8 Date/Time Received?	☒	☐	
2.1.9 Other (describe)?	☒	☐	A revised COC was received by the laboratory via email on 10/13/2017.
2.2 Were the COC records signed and dated upon receipt?	☒	☐	

Additional Comments:

Data Review Checklist for the Validation of Libby Transmission Electron Microscopy (TEM) Data Deliverables

3.0 Sample Result Validation	Yes	No	Comments
3.1 Is the sample preparation method documented and final sample volume recorded?	☒	☐	
3.2 Were the correct number of grid openings used to achieve the specified analytical sensitivity and/or were associated stopping rules invoked?	☒	☐	
3.3 Verify that the following information from the laboratory's bench sheets have been transcribed correctly:			
3.3.1.1 Grid identification?	☒	☐	
3.3.1.2 Grid opening?	☒	☐	
3.3.1.3 Structure type?	☒	☐	
3.3.1.4 Number of primary and secondary structures?	☒	☐	
3.3.1.5 Length and width dimensions?	☒	☐	
3.3.1.6 Structure identification?	☒	☐	
3.3.1.7 Mineral type?	☒	☐	
3.4 Are overloaded samples correctly reported to the specified percent obscuration (i.e. 10%, 25%)?	☐	☒	No samples determined to be overloaded.
3.5 If overloading or uneven loading occurs, or the filters contain loose debris, are samples prepared by an alternate method (i.e. indirect preparation)?	☐	☐	NA
3.6 Verify that the following information is documented correctly:			
3.6.1 Magnification?	☒	☐	
3.6.2 Field or QC sample type?	☒	☐	
3.6.3 Number of grids prepared?	☒	☐	
3.6.4 Filter area in (mm^2)?	☒	☐	
3.6.5 Analysis/preparation date?	☒	☐	
3.7 Verify the totals reported on the count sheets for the various types of structures are correct.	☒	☐	.
3.8 Are the required spectra included for all hits reported (i.e. ED, EDXA, SAED)?	☒	☐	

Additional Comments:

Data Review Checklist for the Validation of Libby Transmission Electron Microscopy (TEM) Data Deliverables

4.0 Quality Control Validation	**Yes**	**No**	**Comments**
4.1 Blanks (if applicable)			
4.1.1 Are laboratory blanks (direct, indirect) prepared, analyzed and reported with the sample set?	☒	☐	One LB was performed. No structures were found.
4.1.2 Are any structures observed in the blanks?	☐	☒	
Note: Laboratory Blanks are also reviewed and evaluated on a program wide basis. Qualification is generally not applied during the validation process; however, the field blanks reported with the sample set can be directly associated with the samples in the sample set and qualification may apply.			
4.2 Recount Same (RS)			
4.2.1 Are recounts same (same analyst on the same grids and grid openings) sample analyses performed and reported with the sample set?	☐	☒	
4.3 Recount Different (RD)			
4.3.1 Are recounts different (different analyst on the same grids and grid openings) sample analyses performed and reported with the sample set?	☐	☒	
4.4 Verified Analyses (VA)			
4.4.1 Are verified analyses (second analysis on same grids and grid openings) performed and reported with the sample set?	☐	☒	
4.5 Repreparation (RP)			
4.5.1 Are repreparation analyses (different analyst on reprepared grids and grid openings) performed and reported with the sample set?	☐	☒	
Note: RS, RD, VA, and RP analyses are reviewed and evaluated on a program wide basis. Qualification is not applied during the validation process; however, the QC samples reported with the sample set are listed in the validation report.			

Additional Comments:

Data Review Checklist for the Validation of Libby Transmission Electron Microscopy (TEM) Data Deliverables

5.0 Calibration & Microscope Alignment Validation	Yes	No	Comments
5.1 Is evidence of the calibration of TEM Screen Magnification provided for all sample analyses?	☒	☐	
5.1.1 Daily Alignment and Cu/Al Calibration?	☒	☐	
5.1.2 Camera Constant Calibration?	☒	☐	
5.1.3 k-Factors?	☒	☐	
5.1.4 Plasma Asher?	☒	☐	
5.2 Are the calibration checks listed above performed at the required frequencies?	☒	☐	
5.3 Are the calibration checks within the specified criteria?	☒	☐	
5.4 Are all calibration checks traceable to the associated samples analyses?	☒	☐	
5.5 If required, are the following additional system checks provided:			
5.5.1 Beam Dose Check?	☒	☐	
5.5.2 Spot Size Check?	☒	☐	
5.5.3 Detector Resolution Check?	☒	☐	
5.5.4 If "no" then qualify the associated results in accordance with the Microscope Alignment and Instrument/Standard Calibration tables in SOP QATS-70-095.			
6.0 Case Narrative Validation			
6.1 Does the data package narrative include descriptions of the following:			
6.1.1 Samples received (matrix/method)?	☒	☐	
6.1.2 Method/Laboratory Modifications?	☒	☐	
6.1.3 Example sample calculation?	☐	☒	
6.1.4 Laboratory blank contamination?	☐	☒	
6.1.5 Quality control analyses outside specified criteria?	☐	☒	
6.1.6 Any problems encountered and subsequent corrective action?	☒	☐	

Additional Comments:

Validated By: Michael Lenkauskas **Date** 10/26/2017

QA Review: Lyndsay Gensler **Date** 11/01/2017

Appendix B

Qualified Result Forms

240917JR01_CV-00048_321723073-0001_TEM-ISO_AR_10-03-17_D_NotQC_C0.xlsm
LIBBY Version Air-DustEDD_38n
TEM Asbestos Structure Count -- ISO 10312

EPA Sample Number	CV-00048
Tag	AL1
Status	ANALYZED
Lab QC Type	NOT QC
Lab Sample Number	321723073-0001
Matrix	Air
Category	Field
Prep	Direct
Analysis Method	TEM-ISO
Est. Particulate Loading	2%

PARAMETERS		
Effective filter area	385.0	mm2
F factor	1.00E+00	
Number of Grid Openings (amphibole)	46	
Number of Grid Openings (chrysotile)	46	
Grid opening area	0.013	mm2
Volume (L) or Area (cm2)	60	L
Sensitivity (amphibole)	1.08E-02	s/cc
Sensitivity (chrysotile)	1.08E-02	s/cc
Area Examined (amphibole)	0.593	mm2
Area Examined (chrysotile)	0.593	mm2

Magnification: LOW

Recording Rules:

Min AR	Min length (um)	Min width (um)
3:1	5	0.25

Stopping Rules:

Target Sens.	Max AE (mm^2)	Max N LA
0.011	1.670	25

COUNTS (based on countable structures only)

Bin	LA	OA	CH	All Asbestos
Total				
PCME	1	0	0	1

CONCENTRATION (s/cc)

Bin	LA	OA	CH	All Asbestos
Total				
PCME	1.08E-02	0.00E+00	0.00E+00	1.08E-02

Total: Length > 0.5 um, Aspect Ratio >= 3:1
PCME: Length > 5 um, Width >= 0.25 um, Aspect Ratio >= 3:1

Chi-sq test for filter loading --
p value: 4.7E-01
interpretation: OK

240917JR01_CV-00050_321723073-0003_TEM-ISO_AR_10-04-17_D_NotQC_C0.xlsm
Version Air-DustEDD_38n

LIBBY
TEM Asbestos Structure Count -- ISO 10312

EPA Sample Number	CV-00050
Tag	AL1
Status	ANALYZED
Lab QC Type	NOT QC
Lab Sample Number	321723073-0003
Matrix	Air
Category	Field
Prep	Direct
Analysis Method	TEM-ISO
Est. Particulate Loading	2%

PARAMETERS		
Effective filter area	385.0	mm2
F factor	1.00E+00	
Number of Grid Openings (amphibole)	46	
Number of Grid Openings (chrysotile)	46	
Grid opening area	0.013	mm2
Volume (L) or Area (cm2)	60	L
Sensitivity (amphibole)	1.08E-02	s/cc
Sensitivity (chrysotile)	1.08E-02	s/cc
Area Examined (amphibole)	0.593	mm2
Area Examined (chrysotile)	0.593	mm2

Magnification: LOW

Recording Rules:	Min AR	Min length (um)	Min width (um)
	3:1	5	0.25

Stopping Rules:	Target Sens.	Max AE (mm^2)	Max N LA
	0.011	1.670	25

COUNTS (based on countable structures only)

Bin	LA	OA	CH	All Asbestos
Total				
PCME	5	0	0	5

CONCENTRATION (s/cc)

Bin	LA	OA	CH	All Asbestos
Total				
PCME	5.41E-02	0.00E+00	0.00E+00	5.41E-02

Total: Length > 0.5 um, Aspect Ratio >= 3:1
PCME: Length > 5 um, Width >= 0.25 um, Aspect Ratio >= 3:1

Chi-sq test for filter loading --
p value: 7.4E-02
interpretation: OK

240917JR01_CV-00052_321723073-0005_TEM-ISO_AR_10-04-17_D_NotQC_C0.xlsm
Version Air-DustEDD_38n

LIBBY
TEM Asbestos Structure Count -- ISO 10312

EPA Sample Number	CV-00052
Tag	AL1
Status	ANALYZED
Lab QC Type	NOT QC
Lab Sample Number	321723073-0005
Matrix	Air
Category	Field
Prep	Direct
Analysis Method	TEM-ISO
Est. Particulate Loading	2%

PARAMETERS		
Effective filter area	385.0	mm2
F factor	1.00E+00	
Number of Grid Openings (amphibole)	46	
Number of Grid Openings (chrysotile)	46	
Grid opening area	0.013	mm2
Volume (L) or Area (cm2)	60	L
Sensitivity (amphibole)	1.08E-02	s/cc
Sensitivity (chrysotile)	1.08E-02	s/cc
Area Examined (amphibole)	0.593	mm2
Area Examined (chrysotile)	0.593	mm2

Magnification: LOW

Recording Rules:

Min AR	Min length (um)	Min width (um)
3:1	5	0.25

Stopping Rules:

Target Sens.	Max AE (mm^2)	Max N LA
0.011	1.670	25

COUNTS (based on countable structures only)

Bin	LA	OA	CH	All Asbestos
Total				
PCME	3	0	0	3

CONCENTRATION (s/cc)

Bin	LA	OA	CH	All Asbestos
Total				
PCME	3.24E-02	0.00E+00	0.00E+00	3.24E-02

Total: Length > 0.5 um, Aspect Ratio >= 3:1
PCME: Length > 5 um, Width >= 0.25 um, Aspect Ratio >= 3:1

Chi-sq test for filter loading --
p value: 5.6E-01
interpretation: OK

240917JR01_CV-00054_321723073-0007_TEM-ISO_AR_10-04-17_D_NotQC_C0.xlsm
Version Air-DustEDD_38n

LIBBY

TEM Asbestos Structure Count -- ISO 10312

EPA Sample Number	CV-00054
Tag	AL1
Status	ANALYZED
Lab QC Type	NOT QC
Lab Sample Number	321723073-0007
Matrix	Air
Category	Field
Prep	Direct
Analysis Method	TEM-ISO
Est. Particulate Loading	2%

PARAMETERS		
Effective filter area	385.0	mm2
F factor	1.00E+00	
Number of Grid Openings (amphibole)	46	
Number of Grid Openings (chrysotile)	46	
Grid opening area	0.013	mm2
Volume (L) or Area (cm2)	60	L
Sensitivity (amphibole)	1.08E-02	s/cc
Sensitivity (chrysotile)	1.08E-02	s/cc
Area Examined (amphibole)	0.593	mm2
Area Examined (chrysotile)	0.593	mm2

Magnification: LOW

Recording Rules:	Min AR	Min length (um)	Min width (um)
	3:1	5	0.25

Stopping Rules:	Target Sens.	Max AE (mm^2)	Max N LA
	0.011	1.670	25

COUNTS (based on countable structures only)

Bin	LA	OA	CH	All Asbestos
Total				
PCME	0	0	0	0

CONCENTRATION (s/cc)

Bin	LA	OA	CH	All Asbestos
Total				
PCME	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Total: Length > 0.5 um, Aspect Ratio >= 3:1
PCME: Length > 5 um, Width >= 0.25 um, Aspect Ratio >= 3:1

Chi-sq test for filter loading --
p value: 1.0E+00
interpretation: OK

240917JR01_CV-00056_321723073-0009_TEM-ISO_AR_10-04-17_D_NotQC_C1.xlsm
Version Air-DustEDD_38n

LIBBY

TEM Asbestos Structure Count -- ISO 10312

EPA Sample Number	CV-00056
Tag	AL1
Status	ANALYZED
Lab QC Type	NOT QC
Lab Sample Number	321723073-0009
Matrix	Air
Category	Field
Prep	Direct
Analysis Method	TEM-ISO
Est. Particulate Loading	2%

PARAMETERS		
Effective filter area	385.0	mm2
F factor	1.00E+00	
Number of Grid Openings (amphibole)	68	
Number of Grid Openings (chrysotile)	68	
Grid opening area	0.013	mm2
Volume (L) or Area (cm2)	40	L
Sensitivity (amphibole)	1.10E-02	s/cc
Sensitivity (chrysotile)	1.10E-02	s/cc
Area Examined (amphibole)	0.877	mm2
Area Examined (chrysotile)	0.877	mm2

Magnification: LOW

Recording Rules:	Min AR	Min length (um)	Min width (um)
	3:1	5	0.25

Stopping Rules:	Target Sens.	Max AE (mm^2)	Max N LA
	0.011	1.670	25

COUNTS (based on countable structures only)

Bin	LA	OA	CH	All Asbestos
Total				
PCME	3	0	0	3

CONCENTRATION (s/cc)

Bin	LA	OA	CH	All Asbestos
Total				
PCME	3.29E-02	0.00E+00	0.00E+00	3.29E-02

Total: Length > 0.5 um, Aspect Ratio >= 3:1
PCME: Length > 5 um, Width >= 0.25 um, Aspect Ratio >= 3:1

Chi-sq test for filter loading --
p value: 5.5E-01
interpretation: OK

APTIM Federal Services, LLC
QATS Program
2700 Chandler Avenue
Las Vegas, Nevada 89120

March 29, 2018

Dr. David Berry
USEPA Region 8
1595 Wynkoop Street (8EPR-SR)
Denver, CO 80202-1129

Document ID #: 1021-03292018-1

EPA CONTRACT NUMBER EP-W-16-016
TASK ORDER NUMBER 1021
QA SUPPORT FOR RI/FS AT THE LIBBY ASBESTOS SITE OU3

Dear Dr. Berry:

Enclosed please find the Release of Validated Data Report for the validation of Transmission Electron Microscopy (TEM) ISO 10312 air sample data, Laboratory Job Number A180017. The six (6) air samples associated with these data were analyzed by TechLaw, Inc. ESAT Region 8 in Golden, CO for the Libby OU3 Winter Hooking/Skidding ABS Study (January, 2018). This report and accompanying appendices are deliverables under Task 07 of the subject Task Order.

If you have any questions, please feel free to contact me.

Sincerely,

Lyndsay K. Gensler
Task Leader, QATS Program
Phone: 702-895-8730
E-Mail Address: lyndsay.gensler@aptim.com
APTIM Federal Services, LLC

cc: QATS Task Order Contract Officer Representative (EPA ASB)
Administrative Contracting Officer (letter only)

RELEASE OF VALIDATED DATA

DATE: 03/29/2018

SUBJECT: Review of Data for Laboratory Job Number: A180017

LABORATORY: TechLaw, Inc. ESAT Region 8, Golden, CO

FROM: Quality Assurance Technical Support (QATS) Program, Las Vegas, NV
APTIM Federal Services, LLC

TO: David Berry, PhD, Environmental Protection Agency, Region 8

QATS personnel reviewed the data for the following case:

Applicable SAP: HOOKOU3-0118

Chain-of-Custody Number: 021318CL01

Method: Transmission Electron Microscopy (TEM) ISO 10312

Applicable Laboratory Modification(s): LB-00016, LB-00029, LB-00066, LB-00067, LB-00085, LB-00091

Number and Type of Samples: 6 Air Samples

EPA Sample Numbers: WH-10000, WH-10002, WH-10004, WH-10006,WH-10008, WH-10010

VALIDATION SUMMARY

Six (6) air samples from Laboratory Job Number A180017, were collected on 02/13/2018 and delivered to TechLaw, Inc. ESAT Region 8 in Golden, CO (ESATR8) for analysis by the TEM ISO 10312 Method on 02/14/2018. The samples were received at the laboratory intact on 02/15/2018, and were analyzed between 02/21/2018 and 02/27/2018.

Listed below are the Data Qualification Summary Table, EDD/Bench Sheet Discrepancy Table, Data Qualifier Table, and Reason Code Table. Note that no data from this data set were qualified.

DATA QUALIFICATION SUMMARY TABLE

Criteria Exceeded	EPA Sample ID	Validation Qualifier	Reason Code
None.			

EDD/BENCH SHEET DISCREPANCY TABLE

EPA Sample ID	C# *	Method/Matrix	Lab. Job No.	Analysis Date	Discrepancy
WH-10000 (listed as WH-1000 on COC)	0	TEM ISO / ABS	A180017	02/21/2018	The EDD incorrectly indicates a Grid/GO as A8, G3-4, where the Bench Sheet identifies it as A8, G3-6.

'*' The EDD correction number in column 2. (i.e., C0, C1, C2, etc..)

DATA QUALIFIER TABLE

Qualifier	Definition
J	The result is estimated. The associated numerical value is an approximation.
UJ	The non-detect result may be inaccurate or imprecise due to the quality of the data generated because certain QC criteria were not met.
R	The sample results are rejected due to serious deficiencies.
X	Validator defined.

TEM REASON CODE TABLE

Reason Code	Definition
MC	Structure/fiber counts and recorded structure dimensions may be inaccurate due to improper or infrequent scope alignment and/or magnification calibrations.
IC	Identification by elemental composition or diffraction pattern may be inaccurate due to improper or infrequent EDXA or camera constant calibration.
PA	Structure/fiber counts and reported concentrations may be inaccurate due to improper or infrequent calibration of the plasma asher.
SC	The reported concentration may be inaccurate due to the condition of samples upon receipt at the laboratory.
DL	The area analyzed, structures counted, or AS do not meet the requirements specified in the applicable SAP Analytical Summary.
ID	The asbestos identification and concentrations may be inaccurate because the recorded structure types are not consistent with those described in the applicable TEM Method and/or laboratory modification(s).

VALIDATION PROCESS

The samples for Laboratory Job Number A180017 were collected from the subject site on 02/13/2018. All samples were prepared and analyzed in accordance with TEM ISO 10312 and SAP Summary HOOKOU3-0118, Revision 0. The Quality Assurance Technical Support (QATS) Program performed validation and a transcription check in accordance with Libby-specific data validation SOPs. Preparation of this report was performed under Task 07 of Task Order 1021.

The sample results on bench sheets and other supporting documents provided in the hardcopy deliverables were compared to the entries in the associated laboratory method-specific EDDs to ensure that the reported results are complete, compliant with the specified methodology, and accurate. Additional support information provided in this data validation report include the QATS Data Review Checklist used to document the data validation process (see Appendix A); and the sample results as reported by the laboratory, with qualifiers as applicable (see Appendix B).

TEM VALIDATION SUMMARY

1. **DATA PACKAGE INVENTORY AND SAMPLE RECEIPT:** The data package included a narrative, Chain-of-Custody (COC) record, EDD files, raw data (bench sheets), and QC samples. The samples were properly packaged, sealed, undamaged, labeled, and were not shipped or stored with bulk samples (air samples only) upon receipt at the laboratory. The COC record was reviewed and found to be acceptable.

2. **SAMPLE PREPARATION:** No preparation documents were provided.

3. **EQUIPMENT CALIBRATION AND PERFORMANCE CHECKS (i.e., daily microscope alignment, screen magnification, EDS calibration, and sensitivity checks):** The equipment alignment and calibration documentation provided separately were performed at the correct frequency, indicating that the instruments were in proper working order during the time of sample analyses.

4. **ANALYTICAL SENSITIVITY:** A sufficient number of grid openings have been analyzed to achieve the required analytical sensitivity and/or the appropriate stopping rule was invoked.

5. **STRUCTURE RECORDING AND ASBESTOS IDENTIFICATION:** The structure recording and asbestos identification were found to be acceptable.

6. **BLANK ANALYSIS:** One laboratory blank (EPA Sample No. LQ-00001) and one field blank (EPA Sample No. WH-10000) were prepared and analyzed with this sample set. There were no structures reported. Note: Blanks are reviewed and evaluated on a program-wide basis. Qualification for blank contamination is generally not applied during the validation process.

7. **ANALYTICAL VARIABILITY:** The laboratory performed the following QC analyses with this sample set:

   - Recount Different (RD) analyses on EPA Sample Nos. WH-10002 and WH-10010.
   - Recount Same (RS) analysis on EPA Sample No. WH-10004.
   - Re-preparation (RP) analysis on EPA Sample No. WH-10008.
   - Verified Analysis (VA) analysis on EPA Sample No. WH-10008.

   Note: QC samples are reviewed and evaluated on a program-wide basis. Qualification for discordant results is not applied during the validation process.

8. **LABORATORY MODIFICATIONS:** Laboratory Modification(s) LB-000016, LB-000029, LB-000066, LB-000067, LB-000085, and LB-000091 were associated with this sample set.

9. **OVERALL ASSESSMENT OF DATA:** The deliverable was found to be complete and accurate. No structures were found in the samples. No qualification of the data is necessary.

REVIEWED BY: Lyndsay Gensler DATE: 03/22/2018

Appendix A

Data Review Checklist

Data Review Checklist for the Validation of Libby Transmission Electron Microscopy (TEM) Data Deliverables

Project Name: Libby OU3 Winter Hooking/Skidding ABS Study	**Laboratory Job No:** A180017
Number of Samples/Matrix: 6 air samples	**Laboratory:** TechLaw, Inc. ESAT Region 8 in Golden, CO
TEM Method/SOP: TEM ISO 10312	**SAP Number:** HOOKOU3-0118, Revision 0
Laboratory Modifications: LB-00016, LB-00029, LB-00066, LB-00067, LB-00085, and LB-00091	

1.0 Data Package Inventory	**Yes**	**No**	**Comments**
1.1 Were the project-specific requirements provided in the SAP Analytical Summary submitted with the data package?	☒	☐	SAP Summary HOOKOU3-0118, Rev. 0 was included in the Data Package.
1.2 Did the received hard copy deliverables contain all the necessary components:			
1.2.1 Narrative?	☒	☐	
1.2.2 Chain-of-Custody?	☒	☐	
1.2.3 EDD file?	☒	☐	
1.2.4 Raw Data - Bench Sheets?	☒	☐	
1.2.5 QC Sample Data:			
1.2.5.1 Blank(s)?	☒	☐	One lab blank (LQ-00001) and one field blank (WH-1000).
1.2.5.2 Recount Same (RS)?	☒	☐	One RS (WH-10004).
1.2.5.3 Recount Different (RD)?	☒	☐	Two RDs (WH-10002 & WH-10010).
1.2.5.4 Verified Analysis (VA)?	☒	☐	
1.2.5.5 Repreparation (RP)?	☒	☐	One VA and one RP (WH-10008).
1.2.6 Calibration Data (submitted quarterly)?	☒	☐	
1.2.7 Communication Records?	☒	☐	
1.2.8 Miscellaneous?	☐	☒	
2.0 Chain-of-Custody Information			
2.1 Was the following information recorded in the hard copy electronic deliverables (if applicable) and is it consistent with the information recorded on the COC:			
2.1.1 COC Number?	☒	☐	Chain-of-Custody #021318CL01.
2.1.2 Case or Sample Set Number?	☒	☐	
2.1.3 EPA Sample ID?	☒	☐	
2.1.4 Date/Time Collected?	☒	☐	
2.1.5 Sample Volume?	☒	☐	
2.1.6 Sample Matrix?	☒	☐	
2.1.7 Analyses (Method)?	☒	☐	Note on COC correcting the Index ID number for EPA Sample No. WH-10000; indicated as WH-1000 on COC. Also noted in EDD.
2.1.8 Date/Time Received?	☒	☐	
2.1.9 Other (describe)?	☒	☐	
2.2 Were the COC records signed and dated upon receipt?	☒	☐	

Additional Comments:

Data Review Checklist for the Validation of Libby Transmission Electron Microscopy (TEM) Data Deliverables

3.0 Sample Result Validation	Yes	No	Comments
3.1 Is the sample preparation method documented and final sample volume recorded?	☒	☐	
3.2 Were the correct number of grid openings used to achieve the specified analytical sensitivity and/or were associated stopping rules invoked?	☒	☐	
3.3 Verify that the following information from the laboratory's bench sheets have been transcribed correctly:			
3.3.1.1 Grid identification?	☒	☐	
3.3.1.2 Grid opening?	☒	☐	
3.3.1.3 Structure type?	☒	☐	
3.3.1.4 Number of primary and secondary structures?	☒	☐	
3.3.1.5 Length and width dimensions?	☒	☐	
3.3.1.6 Structure identification?	☒	☐	
3.3.1.7 Mineral type?	☒	☐	
3.4 Are overloaded samples correctly reported to the specified percent obscuration (i.e. 10%, 25%)?	☐	☐	NA
3.5 If overloading or uneven loading occurs, or the filters contain loose debris, are samples prepared by an alternate method (i.e. indirect preparation)?	☐	☐	NA
3.6 Verify that the following information is documented correctly:			
3.6.1 Magnification?	☒	☐	
3.6.2 Field or QC sample type?	☒	☐	
3.6.3 Number of grids prepared?	☒	☐	
3.6.4 Filter area in (mm^2)?	☒	☐	
3.6.5 Analysis/preparation date?	☒	☐	
3.7 Verify the totals reported on the count sheets for the various types of structures are correct.	☒	☐	.
3.8 Are the required spectra included for all hits reported (i.e. ED, EDXA, SAED)?	☒	☐	

Additional Comments:

Data Review Checklist for the Validation of Libby Transmission Electron Microscopy (TEM) Data Deliverables

4.0 Quality Control Validation	Yes	No	Comments
4.1 Blanks (if applicable)			
4.1.1 Are laboratory blanks (direct, indirect) prepared, analyzed and reported with the sample set?	☒	☐	One (1) laboratory blank (sample LQ-00001) and one field blank (WH-10000) were prepared with this sample set. The samples were reported as ND.
4.1.2 Are any structures observed in the blanks?	☐	☒	
Note: Laboratory Blanks are also reviewed and evaluated on a program wide basis. Qualification is generally not applied during the validation process; however, the field blanks reported with the sample set can be directly associated with the samples in the sample set and qualification may apply.			
4.2 Recount Same (RS)			
4.2.1 Are recounts same (same analyst on the same grids and grid openings) sample analyses performed and reported with the sample set?	☒	☐	One RS performed on EPA Sample No. WH-10004.
4.3 Recount Different (RD)			
4.3.1 Are recounts different (different analyst on the same grids and grid openings) sample analyses performed and reported with the sample set?	☒	☐	One RD performed on EPA Sample Nos. WH-00002 & WH-10010.
4.4 Verified Analyses (VA)			
4.4.1 Are verified analyses (second analysis on same grids and grid openings) performed and reported with the sample set?	☒	☐	One VA performed on EPA Sample No. WH-10008.
4.5 Repreparation (RP)			
4.5.1 Are repreparation analyses (different analyst on reprepared grids and grid openings) performed and reported with the sample set?	☒	☐	One RP performed on EPA Sample No. WH-10008.
Note: RS, RD, VA, and RP analyses are reviewed and evaluated on a program wide basis. Qualification is not applied during the validation process; however, the QC samples reported with the sample set are listed in the validation report.			

Additional Comments:

Data Review Checklist for the Validation of Libby Transmission Electron Microscopy (TEM) Data Deliverables

5.0 Calibration & Microscope Alignment Validation	**Yes**	**No**	**Comments**
5.1 Is evidence of the calibration of TEM Screen Magnification provided for all sample analyses?	☒	☐	
5.1.1 Daily Alignment and Cu/Al Calibration?	☒	☐	
5.1.2 Camera Constant Calibration?	☒	☐	
5.1.3 k-Factors?	☒	☐	
5.1.4 Plasma Asher?	☒	☐	
5.2 Are the calibration checks listed above performed at the required frequencies?	☒	☐	
5.3 Are the calibration checks within the specified criteria?	☒	☐	
5.4 Are all calibration checks traceable to the associated samples analyses?	☒	☐	
5.5 If required, are the following additional system checks provided:			
5.5.1 Beam Dose Check?	☒	☐	
5.5.2 Spot Size Check?	☒	☐	
5.5.3 Detector Resolution Check?	☒	☐	
5.5.4 If "no" then qualify the associated results in accordance with the Microscope Alignment and Instrument/Standard Calibration tables in SOP QATS-70-095.			
6.0 Case Narrative Validation			
6.1 Does the data package narrative include descriptions of the following:			
6.1.1 Samples received (matrix/method)?	☒	☐	
6.1.2 Method/Laboratory Modifications?	☒	☐	
6.1.3 Example sample calculation?	☒	☐	
6.1.4 Laboratory blank contamination?	☐	☒	
6.1.5 Quality control analyses outside specified criteria?	☐	☒	
6.1.6 Any problems encountered and subsequent corrective action?	☐	☒	

Additional Comments:

Validated By: **Lyndsay Gensler** **Date** **03/22/2018**

QA Review: **Timothy Vonnahme** **Date** **03/29/2018**

Appendix B

Qualified Result Forms

021318CL01_WH-10000_A180017-01_TEM-ISO_AR_02-21-18_D_NotQC_C0.xlsm
Version Air-DustEDD_38n

LIBBY
TEM Asbestos Structure Count -- ISO 10312

EPA Sample Number	WH-10000
Tag	AL1
Status	ANALYZED
Lab QC Type	NOT QC
Lab Sample Number	A180017-01
Matrix	Air
Category	Blank
Prep	Direct
Analysis Method	TEM-ISO
Est. Particulate Loading	1%

PARAMETERS		
Effective filter area	385.0	mm2
F factor	1.00E+00	
Number of Grid Openings (amphibole)	98	
Number of Grid Openings (chrysotile)	98	
Grid opening area	0.010	mm2
Volume (L) or Area (cm2)	0	L
Sensitivity (amphibole)	Blank	s/cc
Sensitivity (chrysotile)	Blank	s/cc
Area Examined (amphibole)	1.009	mm2
Area Examined (chrysotile)	1.009	mm2

Magnification: LOW

Recording Rules:

Min AR	Min length (um)	Min width (um)
3:1	5	0.25

Stopping Rules:

Target Sens.	Max AE (mm^2)	Max N LA
	1.000	

COUNTS (based on countable structures only)

Bin	LA	OA	CH	All Asbestos
Total				
PCME	0	0	0	0

CONCENTRATION (s/cc)

Bin	LA	OA	CH	All Asbestos
Total				
PCME				

Total: Length > 0.5 um, Aspect Ratio >= 3:1
PCME: Length > 5 um, Width >= 0.25 um, Aspect Ratio >= 3:1

Chi-sq test for filter loading --
p value: 1.0E+00
interpretation: OK

021318CL01_WH-10002_A180017-03_TEM-ISO_AR_02-22-18_D_NotQC_C0.xlsm
Version Air-DustEDD_38n

LIBBY
TEM Asbestos Structure Count -- ISO 10312

EPA Sample Number	WH-10002
Tag	AL1
Status	ANALYZED
Lab QC Type	NOT QC
Lab Sample Number	A180017-03
Matrix	Air
Category	Field
Prep	Direct
Analysis Method	TEM-ISO
Est. Particulate Loading	4%

PARAMETERS		
Effective filter area	385.0	mm2
F factor	1.00E+00	
Number of Grid Openings (amphibole)	88	
Number of Grid Openings (chrysotile)	88	
Grid opening area	0.010	mm2
Volume (L) or Area (cm2)	120	L
Sensitivity (amphibole)	3.54E-03	s/cc
Sensitivity (chrysotile)	3.54E-03	s/cc
Area Examined (amphibole)	0.906	mm2
Area Examined (chrysotile)	0.906	mm2

Magnification: LOW

Recording Rules:

Min AR	Min length (um)	Min width (um)
3:1	5	0.25

Stopping Rules:

Target Sens.	Max AE (mm^2)	Max N LA
0.0038	3.400	25

COUNTS (based on countable structures only)

Bin	LA	OA	CH	All Asbestos
Total				
PCME	0	0	0	0

CONCENTRATION (s/cc)

Bin	LA	OA	CH	All Asbestos
Total				
PCME	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Total: Length > 0.5 um, Aspect Ratio >= 3:1
PCME: Length > 5 um, Width >= 0.25 um, Aspect Ratio >= 3:1

Chi-sq test for filter loading --
p value: 1.0E+00
interpretation: OK

021318CL01_WH-10004_A180017-05_TEM-ISO_AR_02-23-18_D_NotQC_C0.xlsm
Version Air-DustEDD_38n

LIBBY
TEM Asbestos Structure Count -- ISO 10312

EPA Sample Number	WH-10004
Tag	AL1
Status	ANALYZED
Lab QC Type	NOT QC
Lab Sample Number	A180017-05
Matrix	Air
Category	Field
Prep	Direct
Analysis Method	TEM-ISO
Est. Particulate Loading	3%

PARAMETERS		
Effective filter area	385.0	mm2
F factor	1.00E+00	
Number of Grid Openings (amphibole)	82	
Number of Grid Openings (chrysotile)	82	
Grid opening area	0.010	mm2
Volume (L) or Area (cm2)	120	L
Sensitivity (amphibole)	3.80E-03	s/cc
Sensitivity (chrysotile)	3.80E-03	s/cc
Area Examined (amphibole)	0.845	mm2
Area Examined (chrysotile)	0.845	mm2

Magnification: LOW

Recording Rules:

Min AR	Min length (um)	Min width (um)
3:1	5	0.25

Stopping Rules:

Target Sens.	Max AE (mm^2)	Max N LA
0.0038	3.400	25

COUNTS (based on countable structures only)

Bin	LA	OA	CH	All Asbestos
Total				
PCME	0	0	0	0

CONCENTRATION (s/cc)

Bin	LA	OA	CH	All Asbestos
Total				
PCME	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Total: Length > 0.5 um, Aspect Ratio >= 3:1
PCME: Length > 5 um, Width >= 0.25 um, Aspect Ratio >= 3:1

Chi-sq test for filter loading --
p value: 1.0E+00
interpretation: OK

021318CL01_WH-10006_A180017-07_TEM-ISO_AR_02-23-18_D_NotQC_C0.xlsm
Version Air-DustEDD_38n

LIBBY
TEM Asbestos Structure Count -- ISO 10312

EPA Sample Number	WH-10006
Tag	AL1
Status	ANALYZED
Lab QC Type	NOT QC
Lab Sample Number	A180017-07
Matrix	Air
Category	Field
Prep	Direct
Analysis Method	TEM-ISO
Est. Particulate Loading	3%

PARAMETERS		
Effective filter area	385.0	mm2
F factor	1.00E+00	
Number of Grid Openings (amphibole)	82	
Number of Grid Openings (chrysotile)	82	
Grid opening area	0.010	mm2
Volume (L) or Area (cm2)	120	L
Sensitivity (amphibole)	3.80E-03	s/cc
Sensitivity (chrysotile)	3.80E-03	s/cc
Area Examined (amphibole)	0.845	mm2
Area Examined (chrysotile)	0.845	mm2

Magnification: LOW

Recording Rules:	Min AR	Min length (um)	Min width (um)
	3:1	5	0.25

Stopping Rules:	Target Sens.	Max AE (mm^2)	Max N LA
	0.0038	3.400	25

COUNTS (based on countable structures only)

Bin	LA	OA	CH	All Asbestos
Total				
PCME	0	0	0	0

CONCENTRATION (s/cc)

Bin	LA	OA	CH	All Asbestos
Total				
PCME	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Total: Length > 0.5 um, Aspect Ratio >= 3:1
PCME: Length > 5 um, Width >= 0.25 um, Aspect Ratio >= 3:1

Chi-sq test for filter loading --
p value: 1.0E+00
interpretation: OK

021318CL01_WH-10008_A180017-09_TEM-ISO_AR_02-26-18_D_NotQC_C0.xlsm
Version Air-DustEDD_38n

LIBBY
TEM Asbestos Structure Count -- ISO 10312

EPA Sample Number	WH-10008
Tag	AL1
Status	ANALYZED
Lab QC Type	NOT QC
Lab Sample Number	A180017-09
Matrix	Air
Category	Field
Prep	Direct
Analysis Method	TEM-ISO
Est. Particulate Loading	3%

PARAMETERS		
Effective filter area	385.0	mm2
F factor	1.00E+00	
Number of Grid Openings (amphibole)	82	
Number of Grid Openings (chrysotile)	82	
Grid opening area	0.010	mm2
Volume (L) or Area (cm2)	120	L
Sensitivity (amphibole)	3.80E-03	s/cc
Sensitivity (chrysotile)	3.80E-03	s/cc
Area Examined (amphibole)	0.845	mm2
Area Examined (chrysotile)	0.845	mm2

Magnification: LOW

Recording Rules:

Min AR	Min length (um)	Min width (um)
3:1	5	0.25

Stopping Rules:

Target Sens.	Max AE (mm^2)	Max N LA
0.0038	3.400	25

COUNTS (based on countable structures only)

Bin	LA	OA	CH	All Asbestos
Total				
PCME	1	0	0	1

CONCENTRATION (s/cc)

Bin	LA	OA	CH	All Asbestos
Total				
PCME	3.80E-03	0.00E+00	0.00E+00	3.80E-03

Total: Length > 0.5 um, Aspect Ratio >= 3:1
PCME: Length > 5 um, Width >= 0.25 um, Aspect Ratio >= 3:1

Chi-sq test for filter loading --
p value: 4.8E-01
interpretation: OK

021318CL01_WH-10010_A180017-11_TEM-ISO_AR_02-26-18_D_NotQC_C0.xlsm
Version Air-DustEDD_38n

LIBBY
TEM Asbestos Structure Count -- ISO 10312

EPA Sample Number	WH-10010
Tag	AL1
Status	ANALYZED
Lab QC Type	NOT QC
Lab Sample Number	A180017-11
Matrix	Air
Category	Field
Prep	Direct
Analysis Method	TEM-ISO
Est. Particulate Loading	5%

PARAMETERS		
Effective filter area	385.0	mm2
F factor	1.00E+00	
Number of Grid Openings (amphibole)	84	
Number of Grid Openings (chrysotile)	84	
Grid opening area	0.010	mm2
Volume (L) or Area (cm2)	120	L
Sensitivity (amphibole)	3.71E-03	s/cc
Sensitivity (chrysotile)	3.71E-03	s/cc
Area Examined (amphibole)	0.865	mm2
Area Examined (chrysotile)	0.865	mm2

Magnification: LOW

Recording Rules:

Min AR	Min length (um)	Min width (um)
3:1	5	0.25

Stopping Rules:

Target Sens.	Max AE (mm^2)	Max N LA
0.0038	3.400	25

COUNTS (based on countable structures only)

Bin	LA	OA	CH	All Asbestos
Total				
PCME	1	0	0	1

CONCENTRATION (s/cc)

Bin	LA	OA	CH	All Asbestos
Total				
PCME	3.71E-03	0.00E+00	0.00E+00	3.71E-03

Total: Length > 0.5 um, Aspect Ratio >= 3:1
PCME: Length > 5 um, Width >= 0.25 um, Aspect Ratio >= 3:1

Chi-sq test for filter loading --
p value: 4.8E-01
interpretation: OK

021318CL01_LQ-00001_LT-00431_TEM-ISO_AR_02-26-18_D_LB_C0.xlsm
Version Air-DustEDD_38n

LIBBY
TEM Asbestos Structure Count -- ISO 10312

EPA Sample Number	LQ-00001
Tag	AL1
Status	ANALYZED
Lab QC Type	Lab Blank
Lab Sample Number	LT-00431
Matrix	Air
Category	Blank
Prep	Direct
Analysis Method	TEM-ISO
Est. Particulate Loading	1%

PARAMETERS		
Effective filter area	385.0	mm2
F factor	1.00E+00	
Number of Grid Openings (amphibole)	10	
Number of Grid Openings (chrysotile)	10	
Grid opening area	0.010	mm2
Volume (L) or Area (cm2)	0	L
Sensitivity (amphibole)	Blank	s/cc
Sensitivity (chrysotile)	Blank	s/cc
Area Examined (amphibole)	0.103	mm2
Area Examined (chrysotile)	0.103	mm2

Magnification: HIGH

Recording Rules:

Min AR	Min length (um)	Min width (um)
3:1	0.5	0

Stopping Rules:

Target Sens.	Max AE (mm^2)	Max N LA
	0.100	

COUNTS (based on countable structures only)

Bin	LA	OA	CH	All Asbestos
Total	0	0	0	0
PCME	0	0	0	0

CONCENTRATION (s/cc)

Bin	LA	OA	CH	All Asbestos
Total				
PCME				

Total: Length > 0.5 um, Aspect Ratio >= 3:1
PCME: Length > 5 um, Width >= 0.25 um, Aspect Ratio >= 3:1

Chi-sq test for filter loading --
p value: 1.0E+00
interpretation: OK

021318CL01_WH-10002_A180017-03_TEM-ISO_AR_02-26-18_D_RD_C0.xlsm
Version Air-DustEDD_38n

LIBBY
TEM Asbestos Structure Count -- ISO 10312

EPA Sample Number	WH-10002
Tag	AL1
Status	ANALYZED
Lab QC Type	Recount Different
Lab Sample Number	A180017-03
Matrix	Air
Category	Field
Prep	Direct
Analysis Method	TEM-ISO
Est. Particulate Loading	3%

PARAMETERS		
Effective filter area	385.0	mm2
F factor	1.00E+00	
Number of Grid Openings (amphibole)	10	
Number of Grid Openings (chrysotile)	10	
Grid opening area	0.010	mm2
Volume (L) or Area (cm2)	120	L
Sensitivity (amphibole)	3.11E-02	s/cc
Sensitivity (chrysotile)	3.11E-02	s/cc
Area Examined (amphibole)	0.103	mm2
Area Examined (chrysotile)	0.103	mm2

Magnification: LOW

Recording Rules:	Min AR	Min length (um)	Min width (um)
	3:1	5	0.25

Stopping Rules:	Target Sens.	Max AE (mm^2)	Max N LA
	0.0038	0.103	25

COUNTS (based on countable structures only)

Bin	LA	OA	CH	All Asbestos
Total				
PCME	0	0	0	0

CONCENTRATION (s/cc)

Bin	LA	OA	CH	All Asbestos
Total				
PCME	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Total: Length > 0.5 um, Aspect Ratio >= 3:1
PCME: Length > 5 um, Width >= 0.25 um, Aspect Ratio >= 3:1

Chi-sq test for filter loading --
p value: 1.0E+00
interpretation: OK

021318CL01_WH-10004_A180017-05_TEM-ISO_AR_02-23-18_D_RS_C0.xlsm
Version Air-DustEDD_38n

LIBBY
TEM Asbestos Structure Count -- ISO 10312

EPA Sample Number	WH-10004
Tag	AL1
Status	ANALYZED
Lab QC Type	Recount Same
Lab Sample Number	A180017-05
Matrix	Air
Category	Field
Prep	Direct
Analysis Method	TEM-ISO
Est. Particulate Loading	3%

PARAMETERS		
Effective filter area	385.0	mm2
F factor	1.00E+00	
Number of Grid Openings (amphibole)	10	
Number of Grid Openings (chrysotile)	10	
Grid opening area	0.010	mm2
Volume (L) or Area (cm2)	120	L
Sensitivity (amphibole)	3.11E-02	s/cc
Sensitivity (chrysotile)	3.11E-02	s/cc
Area Examined (amphibole)	0.103	mm2
Area Examined (chrysotile)	0.103	mm2

Magnification: LOW

Recording Rules:	Min AR	Min length (um)	Min width (um)
	3:1	5	0.25

Stopping Rules:	Target Sens.	Max AE (mm^2)	Max N LA
	0.0038	0.103	25

COUNTS (based on countable structures only)

Bin	LA	OA	CH	All Asbestos
Total				
PCME	0	0	0	0

CONCENTRATION (s/cc)

Bin	LA	OA	CH	All Asbestos
Total				
PCME	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Total: Length > 0.5 um, Aspect Ratio >= 3:1
PCME: Length > 5 um, Width >= 0.25 um, Aspect Ratio >= 3:1

Chi-sq test for filter loading --
p value: 1.0E+00
interpretation: OK

021318CL01_WH-10008_A180017-09_TEM-ISO_AR_02-26-18_D_VA_C0.xlsm
Version Air-DustEDD_38n

LIBBY
TEM Asbestos Structure Count -- ISO 10312

EPA Sample Number	WH-10008
Tag	AL1
Status	ANALYZED
Lab QC Type	Verified Analysis
Lab Sample Number	A180017-09
Matrix	Air
Category	Field
Prep	Direct
Analysis Method	TEM-ISO
Est. Particulate Loading	6%

PARAMETERS		
Effective filter area	385.0	mm2
F factor	1.00E+00	
Number of Grid Openings (amphibole)	10	
Number of Grid Openings (chrysotile)	10	
Grid opening area	0.010	mm2
Volume (L) or Area (cm2)	120	L
Sensitivity (amphibole)	3.11E-02	s/cc
Sensitivity (chrysotile)	3.11E-02	s/cc
Area Examined (amphibole)	0.103	mm2
Area Examined (chrysotile)	0.103	mm2

Magnification: LOW

Recording Rules:	Min AR	Min length (um)	Min width (um)
	3:1	5	0.25

Stopping Rules:	Target Sens.	Max AE (mm^2)	Max N LA
	0.0038	0.103	25

COUNTS (based on countable structures only)

Bin	LA	OA	CH	All Asbestos
Total				
PCME	1	0	0	1

CONCENTRATION (s/cc)

Bin	LA	OA	CH	All Asbestos
Total				
PCME	3.11E-02	0.00E+00	0.00E+00	3.11E-02

Total: Length > 0.5 um, Aspect Ratio >= 3:1
PCME: Length > 5 um, Width >= 0.25 um, Aspect Ratio >= 3:1

Chi-sq test for filter loading --
p value: 4.4E-01
interpretation: OK

021318CL01_WH-10008_A180017-09_TEM-ISO_AR_02-27-18_D_RP_C0.xlsm
Version Air-DustEDD_38n

LIBBY
TEM Asbestos Structure Count -- ISO 10312

EPA Sample Number	WH-10008
Tag	AL1
Status	ANALYZED
Lab QC Type	Repreparation
Lab Sample Number	A180017-09
Matrix	Air
Category	Field
Prep	Direct
Analysis Method	TEM-ISO
Est. Particulate Loading	5%

PARAMETERS		
Effective filter area	385.0	mm2
F factor	1.00E+00	
Number of Grid Openings (amphibole)	85	
Number of Grid Openings (chrysotile)	85	
Grid opening area	0.010	mm2
Volume (L) or Area (cm2)	120	L
Sensitivity (amphibole)	3.66E-03	s/cc
Sensitivity (chrysotile)	3.66E-03	s/cc
Area Examined (amphibole)	0.876	mm2
Area Examined (chrysotile)	0.876	mm2

Magnification: LOW

Recording Rules:	Min AR	Min length (um)	Min width (um)
	3:1	5	0.25

Stopping Rules:	Target Sens.	Max AE (mm^2)	Max N LA
	0.0038	3.400	25

COUNTS (based on countable structures only)

Bin	LA	OA	CH	All Asbestos
Total				
PCME	1	0	0	1

CONCENTRATION (s/cc)

Bin	LA	OA	CH	All Asbestos
Total				
PCME	3.66E-03	0.00E+00	0.00E+00	3.66E-03

Total: Length > 0.5 um, Aspect Ratio >= 3:1
PCME: Length > 5 um, Width >= 0.25 um, Aspect Ratio >= 3:1

Chi-sq test for filter loading --
p value: 4.8E-01
interpretation: OK

021318CL01_WH-10010_A180017-11_TEM-ISO_AR_02-27-18_D_RD_C0.xlsm
Version Air-DustEDD_38n

LIBBY
TEM Asbestos Structure Count -- ISO 10312

EPA Sample Number	WH-10010
Tag	AL1
Status	ANALYZED
Lab QC Type	Recount Different
Lab Sample Number	A180017-11
Matrix	Air
Category	Field
Prep	Direct
Analysis Method	TEM-ISO
Est. Particulate Loading	4%

PARAMETERS		
Effective filter area	385.0	mm2
F factor	1.00E+00	
Number of Grid Openings (amphibole)	10	
Number of Grid Openings (chrysotile)	10	
Grid opening area	0.010	mm2
Volume (L) or Area (cm2)	120	L
Sensitivity (amphibole)	3.11E-02	s/cc
Sensitivity (chrysotile)	3.11E-02	s/cc
Area Examined (amphibole)	0.103	mm2
Area Examined (chrysotile)	0.103	mm2

Magnification: LOW

Recording Rules:

Min AR	Min length (um)	Min width (um)
3:1	5	0.25

Stopping Rules:

Target Sens.	Max AE (mm^2)	Max N LA
0.0038	0.103	25

COUNTS (based on countable structures only)

Bin	LA	OA	CH	All Asbestos
Total				
PCME	1	0	0	1

CONCENTRATION (s/cc)

Bin	LA	OA	CH	All Asbestos
Total				
PCME	3.11E-02	0.00E+00	0.00E+00	3.11E-02

Total: Length > 0.5 um, Aspect Ratio >= 3:1
PCME: Length > 5 um, Width >= 0.25 um, Aspect Ratio >= 3:1

Chi-sq test for filter loading --
p value: 4.4E-01
interpretation: OK

Stantec

ATTACHMENT E
2018 WINTER HOOKING/SKIDDING ABS STUDY
FIELD DOCUMENTATION

LIBBY OU3 #1
2018 Winter ABS

Rite in the Rain.
ALL-WEATHER
FIELD
№ 350

CONTENTS

PAGE	REFERENCE	DATE

MADE IN TACOMA
— SINCE 1916 —
Rite in the Rain®
= DEFYING MOTHER NATURE =

ALL-WEATHER
FIELD BOOK

Name Libby OU3
2018 Winter ABS

Address HookinG AND SKiDDinG

Phone

Project STANTEC

MADE USA · RITE GREEN · Archival paper

RiteintheRain.com

JL DARLING LLC
Tacoma, WA 98424-1017 USA
US Pat No. 6,863,940
2-17

Libby Winter ABS 2018

2-2-18

10:00 Pull the Lot Blanks
WH-Lot 03
WH-Lot 04
~ from Lot 49933

10:30 Fed Ex Lot Blanks

2-6-18

13:00 Readiness Call

February 10, 2018 2018 Hooking & Skidding Libby Winter ABS Study

17° F, clear

Mike Chapman of Chapman Construction did a site visit to begin preparation and take measurements of snow depth, temperature, etc. Mike also took photographs of site conditions and provided those to Stantec.

Measurements provided by Mike C. →

Start of skid path snow depth: 11 inches

Appx midway thru skid path snow depth: 9"

End of skid path snow depth: 5 inches

Visual inspection of soil: frozen

Ambient air temp: 17° F

Snow consistency (i.e. firm or mushy): crusty with good snow base on skid trail.

Mike was onsite at appx 1030 AM

2/10/18

February 11, 2018 Hooking & Skidding Winter ABS

15°F Clear

1800 Korey Walsh of Stantec arrives in Libby and begins unloading equipment to hotel.
Mike Chapman, Cory Chapman, and Darrell Schulte are already here.

Chris Lee 2/11/18

February 12, 2018 2018 Winter ABS Hooking & Skidding

15°F, Clear

1100 Chris Lee of Stantec Arrive in Libby.

1130 Arrive at flyway for field prep and respirator fit testing.
Mike Chapman conducts fit tests for Chris Lee, Korey Walsh, and Darrell Schulte. All tests successful.

1415 Arrive at CDM office to conduct kickoff meeting. Attendees are:
Mike Cirian (EPA), Mike Chapman
Cory Chapman (Chapman construction),
Damon Repine Simon Wilson (CDM)
Darrell Schulte (
Chris Lee, Korey Walsh (Stantec)
Paula Weyen-Gellner and Bill Pickens (Stantec; joined via skype).

1500 Meeting concluded. Mike Cirian suggested getting written approval from Jeff Johnson (USFS) that conditions are suitable. Paula Weyen-Gellner will contact him.

1515 Jeff Johnson responded via email that conditions are suitable. We will begin the study as planned.

15°F, Clear

February 12, 2018 2018 Winter ABS Hooking & Skidding

1520 Chris Lee and Korey Walsh begin calibration of pumps and rotometer.
Data collected on separate form:
Appendix 2 - Precision Rotameter Calibration Data sheet.
We are using Rotameter #1.
Data looks good with R^2 value of 0.9985.

1600 Now labeling the pumps and setting flow rates to 2L and 4L/min
Pump #1 and #3 will be set to 2L/min and Pumps #2 and #4 set to 4 L/min.

1620 Pumps calibrated and charging

1700 GPS data and coordinates loaded onto Trimble GeoXT.

START OF PATH LAT -115.448413
LONG 48.42454

END OF PATH LAT -115.447271
LONG 48.422537

[signature] 2/12/18

11°F, Mostly Cloudy

Feb 13, 2018 2018 Winter ABS Hooking & Skidding

830 Stantec arrives at flyway (Chris Lee and Korey Walsh). Begin prepping equipment.

900 Project equipment & supplies are gathered. Get the group together for safety meeting.

930 Begin H&S meeting.

942 All parties have signed HASP Acknowledgment and RMS-2 form. Everyone is suited up in PPE.

955 Onsite personell are: Chris Lee and Korey Walsh, Stantec. Mike and Cory Chapman, Chapman Construction, Darrell Schulte
Simon

957 Mike and Darrell leave in UTV to site. Rest of crew leaving in pickup.

1007 Arrive at Area E. Begin pre study measurements.

1010 Snow collected in a graduated cylinder.

1035 Snow measurements collected on separate field form:
Begin 12.5", mid 6.5, End 11.5"

1037 Begin setting up pumps on 1st sampler

15-20°F, mostly cloudy

February 13, 2018 Winter ABS Hooking Skidding

1040 Darrell is collecting weather data w/ Kestrel and recording on field form.

1041 Collect field blank.

WH-10000 WH-10000

1055 Begin 1st pass on skid trail. Mike Chapman. flow checked

1058 Set up second sampler while Mike is going.

1100 Cory Chapman flow checks:
2 L pump: 3.75 (4.0)
4 L pump: 1.9 (2.0)

1110 15 mins elapsed. Stop to unhook/rehook tree.

1125 Complete 1st ABS run – ABS #1
End flow checks 2L: 1.9 (2.0)
4L: 3.75 (4.0)

1130 Collect samples:

WH-10001 WH-10001 2L

WH-10002 WH-10002 4L

1132 Cory Begins ABS #2.

1147 Cory stop to unhook and rehook the tree.

20°-25°

February 13, 2018 Winter ABS Hooking + Skidding

1202 Cory completes ABS #2

1150 Mike flow checks for ABS #3
2 L: 1.9 (2.0) WH-10005
4 L: 3.75 (4.0) WH-10006

1207 Flow check Cory post ABS #2
2L: 1.9 (2.0)
4L: 3.75 (4.0)

1210 Collect samples:

pen slipped

WH-10003 WH-10003 2L

WH-10004 WH-10004 4L

1212 Mike begins ABS #3

1227 Stop to unhook/rehook tree

1235 Flow check Cory for ABS #4
2L: 1.9 (2.0) WH-10005
4L: 3.75 (4.0) WH-10006

1242 Mike completes ABS #3

1248 Collect samples:

WH-10005 WH-10005 2L

WH-10006 WH-10006 4L

1251 Flow check Post ABS #3
2 L: 1.9 (2.0)
4 L: 3.75 (4.0)

25-30°

February 13, 2018 Winter ABS Hooking & Skidding

1259 (1244) Cory stops to unhook. Began ABS #4 at 1244.

1314 Cory completes ABS #4.

Post ABS flow check:

2L: 1.9 (2.0)

4L: 3.75 (4.0)

1315 Flow check Mike for ABS #5

2L: 1.9 (2.0)

4L: 3.75 (4.0)

Collect samples

WH-10007 WH-10007 2L

WH-10008 WH-10008 4L

1324 Mike begins ABS#5

1339 Stop to unhook and rehook tree.

1354 ~~tree~~. ABS #5 complete

1356 Flow check Post ABS #5

2L: 1.9 (2.0)

4L: 3.75 (4.0)

1400 Collect samples:

WH-10009 WH-10009 2L

WH-10010 WH-10010 4L

1402 Onsite study concluded. Begin packing

30°F

February 13, 2018 Winter ABS Hooking & Skidding

1402 up to leave site. Chapman will leave dozer onsite to decon when its warmer.

1410 Back at pickup truck on pavement.

1417 Removed outer layer of tyvek and disposed of it, along with booties and gloves. Will go to flyway next for personal decon and job debrief.

1428 Back at flyway to decon.

1444 The decon trailer was not winterized by the previous contractor who used it. The pipes and drains are frozen solid. We are deconing with a pump and a hose.

1449 Wilsonsn@cdmsmith.com Simon's email address for coordination.

1503 Leaving flyway. Will get some food now.

1610 Back at hotel to review notes, photos, COCs, etc.

[signature] 2/13/18

20°F Snowing

February ~~13~~ 14, 2018 Winter ABS Hooking & Skidding

815 Leave hotel to take air samples to Troy. Snow fell overnight a couple inches. Still snowing lightly.

845 Samples checked in to the lab. Leave Troy to go to flyway.

930 Arrive at flyway; Mike Chapman Cory Chapman and Paul Rhodes are in the trailer putting on PPE.

945 Mike indicated it will take a couple hours to shuttle the snowmobiles onto site. Korey W and Chris Lee will prepare and ship pumps back, then return to flyway for decon trailer repair.

1015 Drop off the key to the gate at the Canoe Gulch Forest Service Station.

1040 Back at hotel to ship pumps.

1130 Complete snow moisture content measurement. While onsite on 2/13, a graduated cylinder was packed with 9.5" of snow equaling 465 mL and allowed to melt. Final amount

1130 of water in cylinder is 160 mL. 465 mL of snow = 160 mL of water.

1400 Assisted Mike Chapman at flyway by going to store multiple times to purchase supplies. Chris Lee back at hotel for conference call. Korey will make another trip to store and then back to flyway.

[illegible] 2/14/18

1428 Arrived at Flyway.

1437 Leaving the flyway.

1518 Back at hotel.

[illegible] 2/14/18

FEBRUARY 20, 2018 WINTER ABS HOOKING + SKIDDING

845 CORRECTION FOR FIELD BOOK PG 8;
FEBRUARY 13, 2018. AT 1110 AM, MIKE
CHAPMAN (THE OPERATOR) DID NOT HEAR
THE RADIO SIGNAL (THE PROMPT WAS
GIVEN VIA RADIO TO MIKE BUT THE
RADIO DID NOT RECEIVE THE PROMPT)
TO EXIT AND UNHOOK AND REHOOK
THE TREE. MIKE WAS NOT IN
VIEW OF THE TIMEKEEPER, AND
CONTINUED TO SKID THE TREE. AT
APPROXIMATELY 1120 AM. IT WAS
DISCOVERED THAT MIKE DID NOT
COMPLETE THE UNHOOKING/REHOOKING.
AT THAT TIME, MIKE WAS DIRECTED
TO EXIT THE CAB AND COMPLETE
THE MISSED SCENARIO. THIS TOOK
PLACE APPROXIMATELY 10 MINUTES
LATER THAN IT WOULD HAVE WITHIN
THE ALLOTTED 30 MINUTE SAMPLE
COLLECTION PERIOD. THE FILTER
SAMPLE WAS COLLECTED 4 MINUTES
LATER. THIS VARIATION WAS NOTED
AND DISCUSSED WITH THE CDM
OVERSIGHT PERSON AND RELATED
VIA EMAIL AND PHONE MESSAGE
ON FEBRUARY 13 BY 4:30 PM.

CDM OVERSIGHT INDICATED HE
WAS NOT CONCERNED WITH THIS
VARIATION IN THE SAMPLING
SINCE THE UNHOOKING/REHOOKING
SCENARIO DID OCCUR ONE TIME
WITHIN THE 30 MINUTE SAMPLE
COLLECTION PERIOD.

[signature] 2/20/18

MARCH 5, 2018 WINTER ABS Hooking / Skidding

828 ADDING COORDINATES FOR POINTS AT WHICH SNOW DEPTH MEASUREMENTS WERE TAKEN ON FEBRUARY 13, 2018 DURING THE WINTER ABS HOOKING/ SKIDDING EVENT.

LOCATION UTM NAD83 ZONE 11N WGS 84

Tree- Doug Fir 12" DBH 614790.214

Start Skid

Mid Skid

END Skid

KW 3/5/18

LOCATION	UTM NAD83 ZONE 11N		WGS 84	
KW 3/5/18	EASTING	NORTHING	EASTING	NORTHING
Tree- Doug Fir 12" DBH	614790.214	5364647.58	-115.44838	48.4245
Start Skid	614791.124	5364647.67	-115.448372	48.424519
Mid Skid	614859.4401	5364554.103	-115.447474	48.423665
End Skid	614883.619	5364428.786	-115.447182	48.422533

KW 3/5/18

Personal Air FSDS Rev0

OU3 2018 Winter Hooking/Skidding ABS Study
Libby Personal Air Sample
Field Sample Data Sheet (FSDS)

FSDS # **PA - 77**

Field Logbook # 2018 Winter ABS #1 Field Logbook Pages #2 Sampling Team Stantec

	Data Item	1	2	3
*	**Sample ID**	WH-Lot03	WH-Lot04	JLW 2/26/18
*	**Person ID**	NA	NA	
*	**Sample Type (check one)**	☐ During hooking/skidding ☒ NA	☐ During hooking/skidding ☒ NA	☐ During hooking/skidding ☐ NA
*	**Field QC Type (check one)**	☐ Field Sample ☐ Field Blank ☒ Lot Blank	☐ Field Sample ☐ Field Blank ☒ Lot Blank	☐ Field Sample ☐ Field Blank ☐ Lot Blank
	Sample Parent ID *(HV Parent ID = LV Sample ID)*	NA	NA	
*	**Sample Air Volume Type** *(if both HV & LV are collected)*	☒ NA ☐ LV ☐ HV	☒ NA ☐ LV ☐ HV	☐ NA ☐ LV ☐ HV
*	**Cassette Lot No** 49933	**Flow Meter ID** NA		*(For Blanks "Z" through "Pump ID" to "Sample Air Stop Flow" then select NA for "Pump Fault" & enter 0 for Total Time & Quantity)*
*	**Flow Meter Type**	☒ NA ☐ Rotameter ☐ DryCal	☒ NA ☐ Rotameter ☐ DryCal	☐ NA ☐ Rotameter ☐ DryCal
*	**Pump ID**	NA	NA	
*	**Sample Air Start Date**	2-2-18	2-2-18	
*	**Sample Air Start Time**	JK 10:00	JK 10:00	
*	Sample Air Start Flow (L/min)	NA	NA	
*	**Sample Air Stop Date**	2-2-18	2-2-18	
*	**Sample Air Stop Time**	NA	NA	
*	Sample Air Stop Flow (L/min)	NA	NA	JLW 2/26/18
*	**Pump Fault**	☐ No ☒ NA ☐ Yes	☐ No ☒ NA ☐ Yes	☐ No ☐ NA ☐ Yes
	Sample Total Time (min)	Ø	Ø	
	Sample Quantity (L)	NA	NA	
	Sample Field Comments	Lot Blank	Lot Blank	

*Required Field

Filter Diameter = 25mm; Pore Size=.8µ

For Field Team Completion: Completed by: JK QC by: JLW For Data Entry: Entered by: ZS QC by: JK

OU3 2018 Winter Hooking/Skidding ABS Study
Libby Personal Air Sample
Field Sample Data Sheet (FSDS)

FSDS # **PA -** 78

Field Logbook # 1 Field Logbook Pages 8 Sampling Team Stantec

	Data Item	1	2	3
*	**Sample ID**	**WH-10000**	**WH-10001**	**WH-10002**
*	**Person ID**	N/A	mike #1 ~~Mike C #1~~	mike #2 ~~Mike C #2~~
*	**Sample Type (check one)**	☐ During hooking/skidding ☒ NA	☒ During hooking/skidding ☐ NA	☒ During hooking/skidding ☐ NA
*	**Field QC Type (check one)**	☐ Field Sample ☒ Field Blank ☐ Lot Blank	☒ Field Sample ☐ Field Blank ☐ Lot Blank	☒ Field Sample ☐ Field Blank ☐ Lot Blank
	Sample Parent ID *(HV Parent ID = LV Sample ID)*	NA	NA	WH-10001
*	**Sample Air Volume Type** *(if both HV & LV are collected)*	☒ NA ☐ LV ☐ HV	☐ NA ☒ LV ☐ HV	☐ NA ☐ LV ☒ HV
*	**Cassette Lot No** 49933	**Flow Meter ID** Rotameter #1	*(For Blanks "Z" through "Pump ID" to "Sample Air Stop Flow" then select NA for "Pump Fault" & enter 0 for Total Time & Quantity)*	
*	**Flow Meter Type**	☒ NA ☐ Rotameter ☐ DryCal	☐ NA ☒ Rotameter ☐ DryCal	☐ NA ☒ Rotameter ☐ DryCal
*	**Pump ID**	NA	Pump #1	Pump #2
*	**Sample Air Start Date**	2/13/2018	2/13/2018	2/13/2018
*	**Sample Air Start Time**	1041 ~~1100~~ CL	1055 ~~1100~~ 2-26-18	1055 ~~1100~~ 2-26-18
*	Sample Air Start Flow (L/min)		~~4~~ 2 CL	4
*	**Sample Air Stop Date**	2/13/2018	2/13/2018	2/13/2018
*	**Sample Air Stop Time**	~~300~~ 1041	1125 ~~1130~~ 2-26-18	1125 ~~1130~~ 2-26-18
*	Sample Air Stop Flow (L/min)		2L ~~3.75 (4)~~ ~~4L~~ CL	4L ~~4.4 (20)~~ ~~2L~~ CL
*	**Pump Fault**	☒ No ~~☒ NA~~ ☐ Yes	☒ No ☐ NA ☐ Yes	☒ No ☐ NA ☐ Yes
	Sample Total Time (min)	~~NA~~ 30 sec	30 min	30 min
	Sample Quantity (L)	NA	60 L	120 L
	Sample Field Comments	FIELD BLANK	1st 30 min ABS	1st 30 min ABS

*Required Field

Filter Diameter = 25mm; Pore Size=.8μ

For Field Team Completion: Completed by: CCL QC by: [initials] For Data Entry: Entered by: [initials] QC by: [initials]

OU3 2018 Winter Hooking/Skidding ABS Study
Libby Personal Air Sample
Field Sample Data Sheet (FSDS)

FSDS # **PA -** 79

Field Logbook # 1 Field Logbook Pages ~~9~~ 8-9 (CL 2-26-18) Sampling Team Stantec

	Data Item	1	2	3
*	**Sample ID**	**WH-10003**	**WH-10004**	**WH-10005**
*	**Person ID**	Cory #1	Cory #2	Mike #1
*	**Sample Type (check one)**	☑ During hooking/skidding ☐ NA	☑ During hooking/skidding ☐ NA	☑ During hooking/skidding ☐ NA
*	**Field QC Type (check one)**	☑ Field Sample ☐ Field Blank ☐ Lot Blank	☑ Field Sample ☐ Field Blank ☐ Lot Blank	☑ Field Sample ☐ Field Blank ☐ Lot Blank
	Sample Parent ID (*HV Parent ID = LV Sample ID*)	NA	WH-10003	NA
*	**Sample Air Volume Type** (*if both HV & LV are collected*)	☐ NA ☑ LV ☐ HV	☐ NA ☐ LV ☑ HV	☐ NA ☑ LV ☐ HV
*	**Cassette Lot No** 49933	**Flow Meter ID** Rotameter #1	(*For Blanks "Z" through "Pump ID" to "Sample Air Stop Flow" then select NA for "Pump Fault" & enter 0 for Total Time & Quantity)*	
*	**Flow Meter Type**	☐ NA ☑ Rotameter ☐ DryCal	☐ NA ☑ Rotameter ☐ DryCal	☐ NA ☑ Rotameter ☐ DryCal
*	**Pump ID**	Pump ~~#4~~ #3 CL	Pump #4	Pump #1
*	**Sample Air Start Date**	2/13/2018	2/13/2018	2/13/2018
*	**Sample Air Start Time**	1132 ~~1212~~ CL	1132 ~~1212~~ CL	1212
*	Sample Air Start Flow (L/min)	~~4~~ 2L CL	4L	2L
*	**Sample Air Stop Date**	2/13/2018	2/13/2018	2/13/2018
*	**Sample Air Stop Time**	1202	1202	1242
*	Sample Air Stop Flow (L/min)	2L	4L	2L
*	**Pump Fault**	☑ No ☐ NA ☐ Yes	☑ No ☐ NA ☐ Yes	☑ No ☐ NA ☐ Yes
	Sample Total Time (min)	30 min	30 min	30 min
	Sample Quantity (L)	60 L	120 L	60 L
	Sample Field Comments	2nd 30 min ABS	2nd 30 min ABS	3RD 30 min ABS

***Required Field** Filter Diameter = 25mm; Pore Size=.8μ

For Field Team Completion: Completed by: CCL QC by: KW	For Data Entry: Entered by: KW QC by: JL

OU3 2018 Winter Hooking/Skidding ABS Study
Libby Personal Air Sample
Field Sample Data Sheet (FSDS)

FSDS # **PA -** 80

Field Logbook # 1 Field Logbook Pages 9 & 10 Sampling Team Stantec

	Data Item	1	2	3
*	**Sample ID**	**WH-10006**	**WH-10007**	**WH-10008**
*	**Person ID**	Mike #2	Cory #1	Cory #2
*	**Sample Type (check one)**	☑ During hooking/skidding ☐ NA	☑ During hooking/skidding ☐ NA	☑ During hooking/skidding ☐ NA
*	**Field QC Type (check one)**	☑ Field Sample ☐ Field Blank ☐ Lot Blank	☑ Field Sample ☐ Field Blank ☐ Lot Blank	☑ Field Sample ☐ Field Blank ☐ Lot Blank
	Sample Parent ID *(HV Parent ID = LV Sample ID)*	WH-10005	NA	WH-10007
*	**Sample Air Volume Type** *(if both HV & LV are collected)*	☐ NA ☐ LV ☑ HV	☐ NA ☑ LV ☐ HV	☐ NA ☐ LV ☑ HV
*	**Cassette Lot No** 49933	**Flow Meter ID** Rotameter #1		*(For Blanks "Z" through "Pump ID" to "Sample Air Stop Flow" then select NA for "Pump Fault" & enter 0 for Total Time & Quantity)*
*	**Flow Meter Type**	☐ NA ☑ Rotameter ☐ DryCal	☐ NA ☑ Rotameter ☐ DryCal	☐ NA ☑ Rotameter ☐ DryCal
*	**Pump ID**	Pump #2	Pump #3	Pump #4
*	**Sample Air Start Date**	2/13/2018	2/13/2018	2/13/2018
*	**Sample Air Start Time**	1212 (KLW 2/26/18)	1244 (KLW 2/26/18)	1244 (KLW 2/26/18)
*	Sample Air Start Flow (L/min)	4 L	2L	4L
*	**Sample Air Stop Date**	2/13/2018	2/13/2018	2/13/2018
*	**Sample Air Stop Time**	1242	1314	1314
*	Sample Air Stop Flow (L/min)	4 L	2L	4L
*	**Pump Fault**	☑ No ☐ NA ☐ Yes	☑ No ☐ NA ☐ Yes	☑ No ☐ NA ☐ Yes
	Sample Total Time (min)	30 min	30 min	30 min
	Sample Quantity (L)	120 L	60 L	120 L
	Sample Field Comments	3RD 30 min ABS	4th 30 min ABS	4th 30 min ABS

***Required Field** Filter Diameter = 25mm; Pore Size=.8μ

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

OU3 2018 Winter Hooking/Skidding ABS Study
Libby Personal Air Sample
Field Sample Data Sheet (FSDS)

FSDS # **PA -** 81

Field Logbook # 1 Field Logbook Pages 10 Sampling Team Stantec

Data Item	1	2	3
* **Sample ID**	**WH-10009**	**WH-10010**	
* **Person ID**	Mike #1	Mike #2	
* **Sample Type (check one)**	☒ During hooking/skidding ☐ NA	☒ During hooking/skidding ☐ NA	☐ During hooking/skidding ☐ NA
* **Field QC Type (check one)**	☒ Field Sample ☐ Field Blank ☐ Lot Blank	☒ Field Sample ☐ Field Blank ☐ Lot Blank	☐ Field Sample ☐ Field Blank ☐ Lot Blank
Sample Parent ID *(HV Parent ID = LV Sample ID)*	NA	WH-10010	/
* **Sample Air Volume Type** *(if both HV & LV are collected)*	☐ NA ☒ LV ☐ HV	☐ NA ☐ LV ☒ HV	☐ NA ☐ LV ☐ HV
* **Cassette Lot No** 49933	**Flow Meter ID** Rotameter #1		***(For Blanks "Z" through "Pump ID" to "Sample Air Stop Flow" then select NA for "Pump Fault" & enter 0 for Total Time & Quantity)***
* **Flow Meter Type**	☐ NA ☒ Rotameter ☐ DryCal	☐ NA ☒ Rotameter ☐ DryCal	☐ NA ☐ Rotameter ☐ DryCal
* **Pump ID**	Pump #1	Pump #2	ZLW 2/26/18
* **Sample Air Start Date**	2/13/2018	2/13/2018	
* **Sample Air Start Time**	1324	1324	
* **Sample Air Start Flow (L/min)**	2 L	4 L	
* **Sample Air Stop Date**	2/13/2018	2/13/2018	
* **Sample Air Stop Time**	~~2L~~ 1354	1354	
* **Sample Air Stop Flow (L/min)**	2 L	4 L	
* **Pump Fault**	☒ No ☐ NA ☐ Yes	☒ No ☐ NA ☐ Yes	☐ No ☐ NA ☐ Yes
Sample Total Time (min)	30 min	30 min	
Sample Quantity (L)	60 L	120 L	
Sample Field Comments	5th 30 min ABS	5th 30 min ABS	

Column 1 (unused cells): ZLW 2/26/18
Column 2 (unused cells): ZLW 2/26/18

*Required Field

Filter Diameter = 25mm; Pore Size=.8μ

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

LIBBY OU3 – CHAIN-OF-CUSTODY RECORD/REQUEST FOR ANALYSIS

COC No. 020218JK01

PAGE: 1 OF: 1

ENTERED BY (Signature): [signature]

PROJECT MANAGER: Paula Weyen-Gellner

DATE: 2/2/2018

METHOD OF SHIPMENT: Fed Ex

CARRIER/WAYBILL NO.: 972367862403

DESTINATION: Techlaw Inc

SAMPLES							ANALYSIS REQUEST																													
							Asbestos		Non-Asbestos (a)																											
Index ID	Date	Time	Media*	Air Volume (L) or Tree Bark Sample Area (cm^2)	Filtered	Archive	TEM-ISO 10312 (b,c)	PLM (d)		TAL Metals+Boron	Mercury	TOC	DOC	Paste pH	Fluoride	Chloride, Sulfate	Total Phosphorus	Cyanide	VPH	EPH	OPP Pesticides	Chlorinated Pesticides	Herbicides	PCBs	SVOCs	VOCs	TDS, TSS, Nitrite, Alkalinity	Ammonia, Nitrate, TKN	Orthophosphate	Radiochemistry	Radium, Uranium	Hardness			Age core (e)	Medium Code	Remarks
WH-Lot03	2-2-18	10:00	A	Ø			X																													B	
WH-Lot04	2-2-18	10:00	A	Ø			X																													B	

TOTAL NUMBER OF CONTAINERS

LABORATORY COMMENTS/CONDITION OF SAMPLES

Cooler Temp:

RELINQUISHED BY:					RECEIVED BY:		
SIGNATURE	PRINTED NAME	COMPANY	DATE	TIME	SIGNATURE	PRINTED NAME	COMPANY
[signature]	Joan Kester	STANTEC	2/2/18	10:30	Fed Ex		

* Media: AQ - Aqueous SO – Solid A – Air BK – Tree Bark DB – Organic Debris (Duff) TC – Tree Age Core MT – Mammal Tissue

Notes --

(a) Method, container, and preservation details are provided in the attached tables

(b) With Libby-specific modifications. See applicable O3 SAP for counting and stopping rules

(c) See applicable SAP for details on preparation methods.

(d) Preparation by ISSI-LIBBY-01 and analysis by SRC-LIBBY-01 (PLM-Grav) and SRC-LIBBY-03 (PLM-VE)

(e) In accordance with procedures in Phipps (1985).

DISTRIBUTION: PINK: Field Copy YELLOW: Laboratory Copy WHITE: Return to Originator

LIBBY OU3 – CHAIN-OF-CUSTODY RECORD/REQUEST FOR ANALYSIS

COC No.: [illegible]

PAGE: ______ OF: ______

ENTERED BY (Signature): Chris Lee

PROJECT MANAGER: Paula Weyen-Gellner

DATE: 02/13/2018

METHOD OF SHIPMENT: Drop off

CARRIER/WAYBILL NO.: N/A

DESTINATION: Troy SPF

SAMPLES							ANALYSIS REQUEST																											
							Asbestos		Non-Asbestos (a)																									
Index ID	Date	Time	Media*	Air Volume (L) or Tree Bark Sample Area (cm^2)	Filtered	Archive	TEM-ISO 10312 (b,c)	PLM (d)	TAL Metals+Boron	Mercury	TOC	DOC	Paste pH	Fluoride	Chloride, Sulfate	Total Phosphorus	Cyanide	VPH	EPH	OPP Pesticides	Chlorinated Pesticides	Herbicides	PCBs	SVOCs	VOCs	TDS, TSS, Nitrite, Alkalinity	Ammonia, Nitrate, TKN	Orthophosphate	Radiochemistry	Radium, Uranium	Hardness	Age core (e)	Medium	PAIR Remarks
WH-1000	2/13/18	1041	A	ø			X																										2/26-18 CB	
WH-10001	2/13/18	1125 ~~1130~~	A	60			X																										A	L1
WH-10002	2/13/18	1125 ~~1130~~	A	120			X																										A	H1
WH-10003	2/13/18	1202	A	60			X																										A	L2
WH-10004	2/13/18	1202	A	~~60~~ 120			X																										A	H2
WH-10005	2/13/18	1242	A	60			X																										A	L3
WH-10006	2/13/18	1242	A	120			X																										A	H3
WH-10007	2/13/18	1314	A	60			X																										A	L4
WH-10008	2/13/18	1314	A	120			X																										A	H4
WH-10009	2/13/18	1354	A	60			X																										A	L5
WH-10010	2/13/18	1354	A	120			X																										A	H5

Chris Lee 2/13/18

TOTAL NUMBER OF CONTAINERS	LABORATORY COMMENTS/CONDITION OF SAMPLES	Cooler Temp:

RELINQUISHED BY:					RECEIVED BY:		
SIGNATURE	PRINTED NAME	COMPANY	DATE	TIME	SIGNATURE	PRINTED NAME	COMPANY
Chris Lee	Christopher Lee	Stantec	2/13/18	1910	Tressa Fifield	Tressa Fifield	ESAT/R8-Troy 02/14/18 0930

* Media: AQ - Aqueous SO – Solid A – Air BK – Tree Bark DB – Organic Debris (Duff) TC – Tree Age Core MT – Mammal Tissue

Notes --

(a) Method, container, and preservation details are provided in the attached tables

(b) With Libby-specific modifications. See applicable O3 SAP for counting and stopping rules

(c) See applicable SAP for details on preparation methods.

(d) Preparation by ISSI-LIBBY-01 and analysis by SRC-LIBBY-01 (PLM-Grav) and SRC-LIBBY-03 (PLM-VE)

(e) In accordance with procedures in Phipps (1985).

DISTRIBUTION: PINK: Field Copy YELLOW: Laboratory Copy WHITE: Return to Originator

ATTACHMENT F
2018 WINTER HOOKING/SKIDDING ABS STUDY
PHOTOGRAPHIC LOG

Stantec **Photographic Log**

Client:	**WR Grace**	**Project:**	**Winter ABS**
Site Name:	**Libby Mine OU3**	**Site Location:**	**Area E Skid Path**

Photograph ID: 1

Photo Location:
Near start of skid path

Direction:
East

Survey Date:
2/13/2018

Comments:
Collecting snow in graduated cylinder for soil moisture content measurement.

Photograph ID: 2

Photo Location:
Mid point of skid path

Direction:
Northeast

Survey Date:
2/13/2018

Comments:
Measuring snow depth at mid point of skid path.

Client:	**WR Grace**	**Project:**	**Winter ABS**
Site Name:	**Libby Mine OU3**	**Site Location:**	**Area E Skid Path**

Photograph ID: 3

Photo Location:
Start of skid path

Direction:
East

Survey Date:
2/13/2018

Comments:
Sampler with pumps and air cassettes in place; ready to begin sampling.

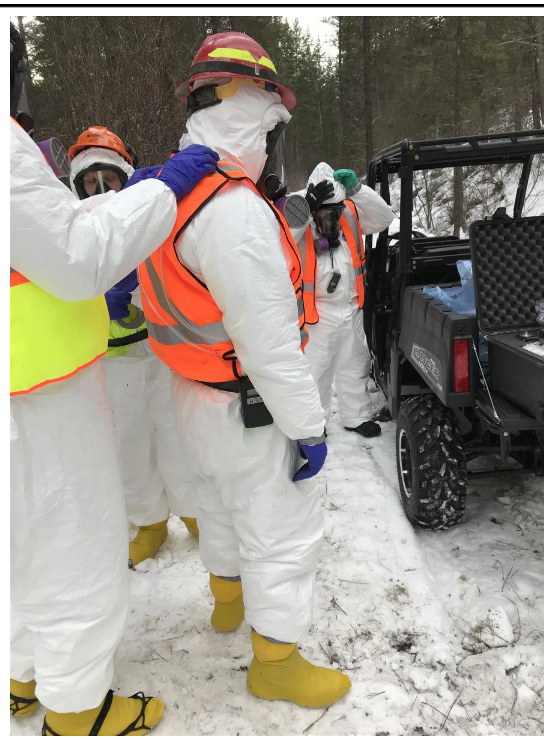
Photograph ID: 4

Photo Location:
Start of skid path

Direction:
South

Survey Date:
2/13/2018

Comments:
Replacing air cassettes.



Client:	WR Grace	Project:	Winter ABS
Site Name:	Libby Mine OU3	Site Location:	Area E Skid Path

Photograph ID: 5

Photo Location:
Start of skid path

Direction:
Northeast

Survey Date:
2/13/2018

Comments:
Snow depth measurement at start of path after first skidding pass.

Photograph ID: 6

Photo Location:
Mid point of skid path

Direction:
North

Survey Date:
2/13/2018

Comments:
Snow depth measurement at mid point of path after first skidding pass.

Client:	WR Grace	Project:	Winter ABS
Site Name:	**Libby Mine OU3**	**Site Location:**	**Area E Skid Path**

Photograph ID: 7

Photo Location:
End of skid trail

Direction:
North

Survey Date:
2/13/2018

Comments:
Unhooking and re-hooking the log.

Photograph ID: 8

Photo Location:
South half of skid trail

Direction:
East

Survey Date:
2/13/2018

Comments:
Re-hooking the log at the 15 minute interval.

Photographic Log

Client:	**WR Grace**	**Project:**	**Winter ABS**
Site Name:	**Libby Mine OU3**	**Site Location:**	**Area E Skid Path**

Photograph ID: 9

Photo Location:
Near mid point of skid path

Direction:
East

Survey Date:
2/13/2018

Comments:
Skidding the log along the skid path.

Photograph ID: 10

Photo Location:
Near mid point of skid path

Direction:
Northeast

Survey Date:
2/13/2018

Comments:
Skidding the log along the skid path.

Stantec **Photographic Log**

Client:	**WR Grace**	**Project:**	**Winter ABS**
Site Name:	**Libby Mine OU3**	**Site Location:**	**Area E Skid Path**

Photograph ID: 11

Photo Location:
South half of skid path

Direction:
North

Survey Date:
2/13/2018

Comments:
Skidding the log along the skid path.

Photograph ID: 12

Photo Location:
End of skid trail

Direction:
North

Survey Date:
2/13/2018

Comments:
Snow cover on skid trail after completion of ABS study.

Stantec

ATTACHMENT G
COMPLETE SETS OF LABORATORY ANALYTICAL DATA

Attachment G: Complete Sets of Laboratory Analytical Data

Table G-1: ACB Treatability Study Asbestos Results For Permeter Air Samples

Phase	Media	ABS Information		Sample Information						Analysis Information											Results			
		Station ID	ABS Scenario Description	Index ID	Sample Date	Field QC Type	Sample Duration (min)	Flow Rate (L/min)	Volume Collected (L)	Analysis ID	Laboratory	Analysis Date	Analysis Method	Lab QC Type	Preparation Method	EFA (mm^2)	GO Size (mm^2)	GOs Examined	F Factor	Sensitivity $(cc)^{-1}$	Total LAA		PCME LAA	
																					N Structures	Air Conc. (s/cc)	N Structures	Air Conc. (s/cc)
2017 ACB	Air	ACB South	Startup & Full Operation	AC-00002	6/21/2017	Field Sample	180	3.0	542	30381	ESATR8	6/28/2017	TEM-ISO	NOT QC	Direct	385	0.0103	4	1	1.7E-02	--	--	0	0
2017 ACB	Air	ACB East	Startup & Full Operation	AC-00004	6/21/2017	Field Sample	180	3.1	551	30368	ESATR8	6/28/2017	TEM-ISO	NOT QC	Direct	385	0.0103	4	1	1.7E-02	--	--	0	0
2017 ACB	Air	ACB North	Startup & Full Operation	AC-00006	6/21/2017	Field Sample	180	3.0	531	30369	ESATR8	6/28/2017	TEM-ISO	NOT QC	Direct	385	0.0103	4	1	1.8E-02	--	--	0	0
2017 ACB	Air	ACB West	Startup & Full Operation	AC-00008	6/21/2017	Field Sample	180	3.0	540	30371	ESATR8	6/28/2017	TEM-ISO	NOT QC	Direct	385	0.0103	4	1	1.7E-02	--	--	0	0
2017 ACB	Air	ACB South	Full Operation & Burn Down	AC-00011	6/21/2017	Field Sample	180	3.0	540	30375	EMSL04	6/28/2017	TEM-ISO	NOT QC	Direct	385	0.0131	4	1	1.4E-02	--	--	0	0
2017 ACB	Air	ACB East	Full Operation & Burn Down	AC-00013	6/21/2017	Field Sample	180	3.0	531	30376	EMSL04	6/28/2017	TEM-ISO	NOT QC	Direct	385	0.0131	4	1	1.4E-02	--	--	1	1.4E-02
2017 ACB	Air	ACB North	Full Operation & Burn Down	AC-00015	6/21/2017	Field Sample	180	3.0	540	30377	EMSL04	6/28/2017	TEM-ISO	NOT QC	Direct	385	0.0131	4	1	1.4E-02	--	--	1	1.4E-02
2017 ACB	Air	ACB West	Full Operation & Burn Down	AC-00017	6/21/2017	Field Sample	180	3.0	536	30379	EMSL04	6/28/2017	TEM-ISO	NOT QC	Direct	385	0.0129	4	1	1.4E-02	--	--	0	0

Notes:

-- analysis was performed under low magnification; only PCME structures were recorded

Filters were prepared and analyzed in basic accordance with TEM ISO 10312:1995(E) (ISO 1995), with all applicable Libby site-specific laboratory modifications.

ABS = activity-based sampling

cc^{-1} = per cubic centimeter

Conc. = concentration

EPA = U.S. Environmental Protection Agency

ID = identification

ISO = International Organization for Standardization

L = liter

LAA = Libby Amphibole Asbestos

min = minute

mm = millimeter

N = number of asbestos structures

PCME = Phase Contrast Microscopy Equivalent

QC = quality control

s/cc = structures per cubic centimeter

TEM = transmission electron microscopy

Attachment G: Complete Sets of Laboratory Analytical Data

Table G-2: ACB Treatability Study Asbestos Results for Ash

Phase	Media	Sample Information					Analysis Information											Results			
																		Total LAA		PCME LAA	
		Station ID	Index ID	Sample Date	Field QC Type	Ash Mass (g, dw)	Analysis ID	Laboratory	Analysis Date	Analysis Method	Lab QC Type	Preparation Method	EFA (mm^2)	GO Size (mm^2)	GOs Examined	F Factor	Sensitivity $(g)^{-1}$	N Structures	Ash Conc. (Ms/g)	N Structures	Ash Conc. (Ms/g)
2017 ACB	Ash	ACB West	AC-00019	6/29/2017	Field Sample	0.25	30383	EMSL04	7/12/2017	TEM-ISO	NOT QC	Indirect - Ashed	1338	0.0128	4	2E-02	5.2E+06	3	1.6E+01	0	0
2017 ACB	Ash	ACB West	AC-00019	6/29/2017	Field Sample	0.25	30384	EMSL04	7/13/2017	TEM-ISO	NOT QC	Indirect - Ashed	1338	0.0128	4	2E-02	5.2E+06	3	1.6E+01	0	0
2017 ACB	Ash	ACB West	AC-00019	6/29/2017	Field Sample	0.25	30385	EMSL04	7/14/2017	TEM-ISO	NOT QC	Indirect - Ashed	1338	0.0128	4	2E-02	5.2E+06	3	1.6E+01	0	0

Notes:

1. Filters were prepared and analyzed in basic accordance with TEM ISO 10312:1995(E) (ISO 1995), with all applicable Libby site-specific laboratory modifications.

ID = identification
Conc. = concentration
dw = dry weight
g = gram
GO = grid opening
ISO = International Organization for Standardization
LAA = Libby Amphibole Asbestos
mm = millimeter
Ms/g = million structures per gram
N = number of asbestos structures
TEM = transmission electron microscopy

Attachment G: Complete Sets of Laboratory Analytical Data
Table G-3: Cover Treatability Study Complete Set of Analytical Data

Scenario	ABS Type*	Sub-plot	Filter	Sample Date	Index ID		Filter Analyzed?	Sample Time		Sample Duration (min)	Sample Air Volume (L)	Analysis Laboratory	Analysis Date	EFA	GO Size (mm^2)	Preparation Method	GOs Examined	F-factor	PCME LAA			Pooled PCME LAA		
					HV	LV		Start	Stop										Sensitivity (cc^{-1})	N Structures	Conc. (s/cc)	Sensitivity (cc^{-1})	N Structures	Conc. (s/cc)
Soil Pre-Cover	Shallow Disturbance ABS	Sub-plot 1	1	9/23/2017	CV-00038	CV-00039	CV-00038	9:09	9:24	15	60	EMSL04	10/2/2017	385	0.0129	Direct	46	1	0.011	4	0.043	0.0036	6	0.022
			2	9/23/2017	CV-00040	CV-00041	CV-00040	9:30	9:45	15	60	EMSL04	10/2/2017	385	0.0129	Direct	46	1	0.011	1	0.011			
			3	9/23/2017	CV-00042	CV-00043	CV-00042	9:48	10:03	15	60	EMSL04	10/3/2017	385	0.0129	Direct	46	1	0.011	1	0.011			
		Sub-plot 2	1	9/23/2017	CV-00044	CV-00045	CV-00044	10:06	10:21	15	60	EMSL04	10/3/2017	385	0.0129	Direct	46	1	0.011	4	0.043	0.0036	10	0.036
			2	9/23/2017	CV-00046	CV-00047	CV-00046	10:23	10:38	15	60	EMSL04	9/30/2017	385	0.0129	Direct	46	1	0.011	5	0.054			
			3	9/23/2017	CV-00048	CV-00049	CV-00048	10:39	10:54	15	60	EMSL32	10/3/2017	385	0.0129	Direct	46	1	0.011	1	0.011			
		Sub-plot 3	1	9/23/2017	CV-00050	CV-00051	CV-00050	10:57	11:12	15	60	EMSL32	10/4/2017	385	0.0129	Direct	46	1	0.011	5	0.054	0.0036	8	0.029
			2	9/23/2017	CV-00052	CV-00053	CV-00052	11:13	11:28	15	60	EMSL32	10/4/2017	385	0.0129	Direct	46	1	0.011	3	0.032			
			3	9/23/2017	CV-00054	CV-00055	CV-00054	11:29	11:44	15	60	EMSL32	10/4/2017	385	0.0129	Direct	46	1	0.011	0	0			
	Deep Disturbance ABS	Sub-plot 1	1	9/23/2017	CV-00056	CV-00057	CV-00056	11:49	11:59	10	40	EMSL32	10/4/2017	385	0.0129	Direct	68	1	0.011	3	0.033	0.0036	16	0.058
			2	9/23/2017	CV-00058	CV-00059	CV-00058	12:00	12:10	10	40	ESATR8	10/4/2017	385	0.0103	Direct	88	1	0.011	5	0.053			
			3	9/23/2017	CV-00060	CV-00061	CV-00060	12:11	12:21	10	40	ESATR8	10/5/2017	385	0.0103	Direct	85	1	0.011	8	0.088			
		Sub-plot 2	1	9/23/2017	CV-00062	CV-00063	CV-00062	12:23	12:33	10	40	ESATR8	10/6/2017	385	0.0103	Direct	85	1	0.011	15	0.16	0.0036	40	0.14
			2	9/23/2017	CV-00064	CV-00065	CV-00064	12:34	12:44	10	40	ESATR8	10/10/2017	385	0.0103	Direct	87	1	0.011	10	0.11			
			3	9/23/2017	CV-00066	CV-00067	CV-00066	12:47	12:57	10	40	ESATR8	10/12/2017	385	0.0103	Direct	87	1	0.011	15	0.16			
		Sub-plot 3	1	9/23/2017	CV-00068	CV-00069	CV-00068	12:59	13:09	10	40	EMSL04	10/2/2017	385	0.0129	Direct	68	1	0.011	2	0.022	0.0037	10	0.037
			2	9/23/2017	CV-00071	CV-00070	CV-00071	13:10	13:20	10	40	EMSL04	10/2/2017	385	0.0129	Direct	68	1	0.011	0	0			
			3	9/23/2017	CV-00072	CV-00073	CV-00072	13:22	13:32	10	40	EMSL04	10/4/2017	385	0.0129	Direct	68	1	0.011	8	0.088			
Vegetative Cover	Shallow Disturbance ABS	Sub-plot 1	1	9/22/2017	CV-00002	CV-00003	CV-00002	8:51	9:06	15	60	EMSL32	11/2/2017	385	0.0128	Direct	23	1	0.022	0	0	0.0073	6	0.044
			2	9/22/2017	CV-00004	CV-00005	CV-00004	9:23	9:38	15	60	EMSL32	11/2/2017	385	0.0128	Direct	23	1	0.022	6	0.13			
			3	9/22/2017	CV-00006	CV-00007	CV-00006	9:47	10:02	15	60	EMSL32	11/2/2017	385	0.0128	Direct	23	1	0.022	0	0			
		Sub-plot 2	1	9/22/2017	CV-00008	CV-00009	CV-00008	10:10	10:25	15	60	EMSL32	11/2/2017	385	0.0128	Direct	23	1	0.022	1	0.022	0.0072	16	0.12
			2	9/22/2017	CV-00010	CV-00011	CV-00010	10:27	10:42	15	60	EMSL32	11/6/2017	385	0.0128	Direct	23	1	0.022	12	0.26			
			3	9/22/2017	CV-00012	CV-00013	CV-00012	10:48	11:03	15	60	EMSL04	11/10/2017	385	0.0131	Direct	23	1	0.021	3	0.064			
		Sub-plot 3	1	9/22/2017	CV-00014	CV-00015	CV-00014	11:11	11:26	15	60	EMSL04	11/10/2017	385	0.0131	Direct	23	1	0.021	3	0.064	0.0071	4	0.028
			2	9/22/2017	CV-00016	CV-00017	CV-00016	11:28	11:43	15	60	EMSL04	11/13/2017	385	0.0131	Direct	23	1	0.021	1	0.021			
			3	9/22/2017	CV-00018	CV-00019	CV-00018	11:48	12:03	15	60	EMSL04	11/13/2017	385	0.0131	Direct	23	1	0.021	0	0			
	Deep Disturbance ABS	Sub-plot 1	1	9/22/2017	CV-00020	CV-00021	CV-00020	12:23	12:33	10	40	EMSL04	11/10/2017	385	0.0131	Direct	13	1	0.057	0	0	0.019	4	0.077
			2	9/22/2017	CV-00022	CV-00023	CV-00022	12:36	12:46	10	40	ESATR8	10/25/2017	385	0.0103	Direct	16	1	0.058	2	0.12			
			3	9/22/2017	CV-00024	CV-00025	CV-00024	12:49	12:59	10	40	ESATR8	10/25/2017	385	0.0103	Direct	16	1	0.058	2	0.12			
		Sub-plot 2	1	9/22/2017	CV-00026	CV-00027	CV-00027	13:04	13:14	10	20	ESATR8	11/7/2017	385	0.0103	Direct	34	1	0.055	0	0	0.019	1	0.019
			2	9/22/2017	CV-00028	CV-00029	CV-00028	13:15	13:25	10	40	ESATR8	10/26/2017	385	0.0103	Direct	16	1	0.058	1	0.058			
			3	9/22/2017	CV-00030	CV-00031	CV-00030	13:27	13:37	10	40	ESATR8	10/27/2017	385	0.0103	Direct	16	1	0.058	0	0			
		Sub-plot 3	1	9/22/2017	CV-00032	CV-00033	CV-00032	13:41	13:51	10	40	ESATR8	10/30/2017	385	0.0103	Direct	16	1	0.058	1	0.058	0.019	1	0.019
			2	9/22/2017	CV-00034	CV-00035	CV-00034	13:52	14:02	10	40	ESATR8	10/30/2017	385	0.0103	Direct	16	1	0.058	0	0			
			3	9/22/2017	CV-00037	CV-00036	CV-00037	14:04	14:14	10	40	ESATR8	10/30/2017	385	0.0103	Direct	16	1	0.058	0	0			

Notes:

red — HV filter was analyzed but rejected because it failed the Chi-Sq test for loading evenness

filter analyzed

*Shallow disturbance ABS air samples were collected for 45 minutes total (15 minutes each sample); deep disturbance ABS air samples were collected for 30 minutes total (10 minutes per sample).

Filters were prepared and analyzed in basic accordance with TEM ISO 10312:1995(E) (ISO 1995), with all applicable Libby site-specific laboratory modifications.

ABS = activity-based sampling
cc^{-1} = per cubic centimeter of air
Conc. = concentration
GO = grid opening
HV = high volume
ID = identification
ISO = International Organization for Standardization
L = liter
LAA = Libby Amphibole Asbestos
LV = low volume
min = minute
N = number
PCME = phase contrast microscopy - equivalent
s/cc = structures per cubic centimeter
TEM = transmission electron microscopy

Attachment G: Complete Sets of Laboratory Analytical Data
Table G-3: Cover Treatability Study Complete Set of Analytical Data

Scenario	ABS Type*	Sub-plot	Filter	Sample Date	Index ID		Filter Analyzed?	Sample Time		Sample Duration (min)	Sample Air Volume (L)	Analysis Laboratory	Analysis Date	EFA	GO Size (mm^2)	Preparation Method	GOs Examined	F-factor	PCME LAA			Pooled PCME LAA		
					HV	LV		Start	Stop										Sensitivity (cc^{-1})	N Structures	Conc. (s/cc)	Sensitivity (cc^{-1})	N Structures	Conc. (s/cc)
Thin Biomass (1")	Shallow Disturbance ABS	Sub-plot 1	1	9/24/2017	CV-00076	CV-00077	CV-00076	7:56	8:11	15	61	ESATR8	11/30/2017	385	0.0103	Direct	28	1	0.022	1	0.022			
			2	9/24/2017	CV-00078	CV-00079	CV-00078	8:13	8:28	15	60	ESATR8	12/1/2017	385	0.0103	Direct	34	1	0.018	1	0.018	0.0068	10	0.068
			3	9/24/2017	CV-00080	CV-00081	CV-00080	8:30	8:45	15	60	ESATR8	12/1/2017	385	0.0103	Direct	29	1	0.021	8	0.17			
		Sub-plot 2	1	9/24/2017	CV-00082	CV-00083	CV-00082	8:48	9:03	15	61	ESATR8	12/5/2017	385	0.0103	Direct	30	1	0.020	0	0			
			2	9/24/2017	CV-00084	CV-00085	CV-00084	9:05	9:20	15	60	ESATR8	12/7/2017	385	0.0103	Direct	29	1	0.021	1	0.021	0.0070	4	0.028
			3	9/24/2017	CV-00086	CV-00087	CV-00086	9:22	9:37	15	60	ESATR8	12/7/2017	385	0.0103	Direct	30	1	0.021	3	0.062			
		Sub-plot 3	1	9/24/2017	CV-00088	CV-00089	CV-00088	9:39	9:54	15	60	ESATR8	12/8/2017	385	0.0103	Direct	29	1	0.021	0	0			
			2	9/24/2017	CV-00090	CV-00091	CV-00090	9:56	10:11	15	60	ESATR8	12/11/2017	385	0.0103	Direct	29	1	0.021	1	0.021	0.0072	5	0.036
			3	9/24/2017	CV-00092	CV-00093	CV-00092	10:13	10:28	15	60	ESATR8	12/14/2017	385	0.0103	Direct	29	1	0.021	4	0.086			
	Deep Disturbance ABS	Sub-plot 1	1	9/24/2017	CV-00094	CV-00095	CV-00094	10:32	10:42	10	40	ESATR8	12/18/2017	385	0.0103	Direct	16	1	0.058	0	0			
			2	9/24/2017	CV-00096	CV-00097	CV-00096	10:43	10:53	10	40	EMSL04	12/1/2017	385	0.0129	Direct	13	1	0.057	1	0.057	0.019	2	0.038
			3	9/24/2017	CV-00098	CV-00099	CV-00098	10:54	11:04	10	40	EMSL04	12/1/2017	385	0.0129	Direct	13	1	0.057	1	0.057			
		Sub-plot 2	1	9/24/2017	CV-00100	CV-00101	CV-00100	11:05	11:15	10	40	EMSL04	12/1/2017	385	0.0129	Direct	13	1	0.057	0	0			
			2	9/24/2017	CV-00102	CV-00103	CV-00102	11:16	11:26	10	40	EMSL04	12/1/2017	385	0.0129	Direct	13	1	0.057	0	0	0.019	1	0.019
			3	9/24/2017	CV-00104	CV-00105	CV-00104	11:28	11:38	10	40	EMSL32	11/30/2017	385	0.0129	Direct	13	1	0.057	1	0.057			
		Sub-plot 3	1	9/24/2017	CV-00106	CV-00107	CV-00106	11:40	11:50	10	40	EMSL32	11/30/2017	385	0.0129	Direct	14	1	0.053	0	0			
			2	9/24/2017	CV-00108	CV-00109	CV-00108	11:51	12:01	10	40	EMSL32	11/30/2017	385	0.0129	Direct	13	1	0.057	0	0	0.019	2	0.037
			3	9/24/2017	CV-00110	CV-00111	CV-00110	12:02	12:12	10	40	EMSL32	11/30/2017	385	0.0129	Direct	13	1	0.057	2	0.11			
Thick Biomass (4")	Shallow Disturbance ABS	Sub-plot 1	1	9/25/2017	CV-00112	CV-00113	CV-00112	7:45	8:00	15	60	ESATR8	11/2/2017	385	0.0103	Direct	30	1	0.021	1	0.021			
			2	9/25/2017	CV-00114	CV-00115	CV-00114	8:01	8:16	15	60	ESATR8	11/2/2017	385	0.0103	Direct	30	1	0.021	0	0	0.0069	3	0.021
			3	9/25/2017	CV-00116	CV-00117	CV-00116	8:17	8:32	15	60	ESATR8	11/2/2017	385	0.0103	Direct	30	1	0.021	2	0.042			
		Sub-plot 2	1	9/25/2017	CV-00118	CV-00119	CV-00118	8:34	8:49	15	60	ESATR8	11/3/2017	385	0.0103	Direct	30	1	0.021	0	0			
			2	9/25/2017	CV-00120	CV-00121	CV-00120	8:50	9:05	15	60	ESATR8	11/3/2017	385	0.0103	Direct	30	1	0.021	1	0.021	0.0069	2	0.014
			3	9/25/2017	CV-00122	CV-00123	CV-00122	9:06	9:21	15	60	ESATR8	11/9/2017	385	0.0103	Direct	30	1	0.021	1	0.021			
		Sub-plot 3	1	9/25/2017	CV-00124	CV-00125	CV-00124	9:23	9:38	15	60	ESATR8	11/10/2017	385	0.0103	Direct	30	1	0.021	0	0			
			2	9/25/2017	CV-00126	CV-00127	CV-00126	9:39	9:54	15	60	ESATR8	11/10/2017	385	0.0103	Direct	30	1	0.021	1	0.021	0.0069	2	0.014
			3	9/25/2017	CV-00128	CV-00129	CV-00128	9:55	10:10	15	60	ESATR8	11/13/2017	385	0.0103	Direct	30	1	0.021	1	0.021			
	Deep Disturbance ABS	Sub-plot 1	1	9/25/2017	CV-00130	CV-00131	CV-00130	10:12	10:22	10	40	ESATR8	11/13/2017	385	0.0103	Direct	16	1	0.058	1	0.058			
			2	9/25/2017	CV-00132	CV-00133	CV-00132	10:23	10:33	10	40	EMSL04	10/26/2017	385	0.0131	Direct	14	1	0.052	0	0	0.019	2	0.037
			3	9/25/2017	CV-00134	CV-00135	CV-00134	10:34	10:44	10	40	EMSL04	10/26/2017	385	0.0131	Direct	13	1	0.057	1	0.057			
		Sub-plot 2	1	9/25/2017	CV-00136	CV-00137	CV-00136	10:46	10:56	10	40	EMSL04	10/26/2017	385	0.0131	Direct	13	1	0.057	1	0.057			
			2	9/25/2017	CV-00138	CV-00139	CV-00138	10:57	11:07	10	40	EMSL04	10/26/2017	385	0.0131	Direct	13	1	0.057	0	0	0.019	1	0.019
			3	9/25/2017	CV-00140	CV-00141	CV-00140	11:08	11:18	10	40	EMSL04	10/26/2017	385	0.0131	Direct	13	1	0.057	0	0			
		Sub-plot 3	1	9/25/2017	CV-00142	CV-00143	CV-00142	11:20	11:30	10	40	EMSL32	11/6/2017	385	0.0128	Direct	13	1	0.058	1	0.058			
			2	9/25/2017	CV-00144	CV-00145	CV-00144	11:31	11:41	10	40	EMSL32	11/6/2017	385	0.0128	Direct	13	1	0.058	0	0	0.019	3	0.058
			3	9/25/2017	CV-00146	CV-00147	CV-00146	11:42	11:52	10	40	EMSL32	11/6/2017	385	0.0128	Direct	13	1	0.058	2	0.12			

Notes:

red HV filter was analyzed but rejected because it failed the Chi-Sq test for loading evenness

filter analyzed

*Shallow disturbance ABS air samples were collected for 45 minutes total (15 minutes each sample); deep disturbance ABS air samples were collected for 30 minutes total (10 minutes per sample).

Filters were prepared and analyzed in basic accordance with TEM ISO 10312:1995(E) (ISO 1995), with all applicable Libby site-specific laboratory modifications.

ABS = activity-based sampling
cc^{-1} = per cubic centimeter of air
Conc. = concentration
GO = grid opening
HV = high volume
ID = identification
ISO = International Organization for Standardization
L = liter
LAA = Libby Amphibole Asbestos
LV = low volume
min = minute
N = number
PCME = phase contrast microscopy - equivalent
s/cc = structures per cubic centimeter
TEM = transmission electron microscopy

Appendix D: 2018 Winter Hooking/Skidding ABS Study Complete Set of Analytical Data

Sample Event	Index ID		Filter Analyzed?	Sample Date	Sample Time		Sample Air Volume (L)	Sample Duration (min)	Analysis Laboratory	Analysis Date	Preparation Method	EFA	GO Size (mm^2)	F-factor	GOs Examined	Sensitivity (cc^{-1})	PCME LA		TAE	Pooled PCME LA		
	HV	LV			Start	Stop											N Structures	Conc. (s/cc)		Sensitivity (cc^{-1})	N Structures	Conc. (s/cc)
Winter ABS 2018	WH-10002	WH-10001	WH-10002	2/13/2018	10:55 AM	11:25 AM	120	30	ESATR8	2/22/2018	Direct	385	0.0103	1	88	0.0035	0	0	283	0.00075	2	0.0015
	WH-10004	WH-10003	WH-10004	2/13/2018	11:32 AM	12:02 PM	120	30	ESATR8	2/23/2018	Direct	385	0.0103	1	82	0.0038	0	0	263			
	WH-10006	WH-10005	WH-10006	2/13/2018	12:12 PM	12:42 PM	120	30	ESATR8	2/23/2018	Direct	385	0.0103	1	82	0.0038	0	0	263			
	WH-10008	WH-10007	WH-10008	2/13/2018	12:44 PM	1:14 PM	120	30	ESATR8	2/26/2018	Direct	385	0.0103	1	82	0.0038	1	0.0038	263			
	WH-10010	WH-10009	WH-10010	2/13/2018	1:24 PM	1:54 PM	120	30	ESATR8	2/26/2018	Direct	385	0.0103	1	84	0.0037	1	0.0037	270			

Notes:

Filters were prepared and analyzed in basic accordance with TEM ISO 10312:1995(E) (ISO 1995), with all applicable Libby site-specific laboratory modifications.

All samples were collected from Area E.

ABS = activity-based sampling

cc^{-1} = per cubic centimeter of air

Conc. = concentration

GO = grid opening

HV = high volume

ID = identification

ISO = International Organization for Standardization

L = liter

LA = Libby amphibole asbestos

LV = low volume

min = minute

N = number

PCME = phase contrast microscopy - equivalent

s/cc = structures per cubic centimeter

TEM = transmission electron microscopy

ATTACHMENT H
2018 WINTER HOOKING/SKIDDING ABS STUDY
FIELD DATA AND LOCATION COORDINATES

Attachment H: 2018 Winter Hooking/Skidding ABS Study Field Data and Location Coordinates
Table H-1: Meteorological Data Downloaded from Station LBBM8

 # STATION: LBBM8 **# LONGITUDE: -115.566667**
 # STATION NAME: LIBBY **# ELEVATION [ft]: 2070**
 # LATITUDE: 48.383333 **# STATE: MT**

Date	Temperature	Relative Humidity	Wind Direction	Wind Speed	Precipitation Accumulation	1 Hour Precipitation
(MST)	(^{o}F)	(%)		(mph)	(inches)	(inches)
2/13/2018 13:25	27	47	SW	1G4	8.12	
2/13/2018 12:25	23	55	NNE	1G4	8.12	
2/13/2018 11:25	19	64		CALM	8.12	
2/13/2018 10:25	16	68		CALM	8.12	
2/13/2018 9:25	11	80		CALM	8.12	
2/13/2018 8:25	8	83		CALM	8.12	
2/13/2018 7:25	7	84		CALM	8.12	
2/13/2018 6:25	7	83		CALM	8.12	
2/13/2018 5:25	8	83		CALM	8.12	
2/13/2018 4:25	9	83		CALM	8.12	
2/13/2018 3:25	7	83		CALM	8.12	
2/13/2018 2:25	7	83		CALM	8.12	
2/13/2018 1:25	9	85		CALM	8.12	
2/13/2018 0:25	9	85		CALM	8.12	
2/12/2018 23:25	10	83		CALM	8.12	
2/12/2018 22:25	12	80		CALM	8.12	
2/12/2018 21:25	12	77		CALM	8.12	
2/12/2018 20:25	14	72		CALM	8.12	
2/12/2018 19:25	17	69		CALM	8.12	
2/12/2018 18:25	20	60		CALM	8.12	
2/12/2018 17:25	25	38		CALM	8.12	
2/12/2018 16:25	26	33	SW	1G4	8.12	
2/12/2018 15:25	28	31	SE	1G5	8.12	
2/12/2018 14:25	29	26	SW	2G7	8.12	
2/12/2018 13:25	24	33	S	1G5	8.12	
2/12/2018 12:25	21	40		CALM	8.12	
2/12/2018 11:25	17	45	ESE	1G4	8.12	

Notes:
Time and meteorological conditions during ABS activities are highlighted in yellow.
Wind direction is reported in the direction from which it originates.

^{o}F	degree Fahrenheit
%	percent
mph	miles per hour

Attachment H: 2018 Winter Hooking/Skidding ABS Study Field Data and Location Coordinates
Table H-2: Meteorological Data Measured using a Pocket Weather Meter

Date	Time	Air Temperature (°F)	Relative Humidity (%)	Wind Speed (mph)	Wind Direction	Source/Notes
2/10/2018	10:30	17	NR	NR	NR	note in field book
2/13/2018	8:30-10:37	11	NR	NR	NR	note in field book
2/13/2018	10:44	14	49	1.5	NR	measurements recorded on field data sheet
2/13/2018	10:40-11:47	15-20	NR	NR	NR	note in field book
2/13/2018	12:02-12:51	20-25	NR	NR	NR	note in field book
2/13/2018	12:59-14:02	25-30	NR	NR	NR	note in field book
2/13/2018	14:06	31	42	0	NR	measurements recorded on field data sheet

Notes:
Time and meteorological conditions during ABS activities are highlighted in yellow.
Wind direction is reported in the direction from which it originates.

NR	not recorded
°F	degree Fahrenheit
%	percent
mph	miles per hour

Attachment H: 2018 Winter Hooking/Skidding ABS Study Field Data and Location Coordinates
Table F-3: Snow Depth Measurements and Visual Inspection of Soil and Snow Conditions

Date	Time	Average Snow Depth (inches)				Visual Inspection of Soil and Snow	Note
		Start of Skid Path	Mid Point of Skid Path	Average of Skid Path	Overall Average		
2/10/2018	10:30	11.0	9.0	5.0	8.3	frozen soil; crusty snow	pre-ABS study conditions
2/13/2018	10:19-10:30	12.5	6.5	11.5	10.2	NR	pre-ABS study conditions
2/13/2018	10:59-11:20	9.0	6.8	10.8	8.9	NR	measurements during first pass on skid path
2/13/2018	11:38-12:00	8.1	7.0	11.0	7.5	NR	measurements during second pass on skid path
2/13/2018	12:30-12:39	8.0	6.3	9.3	7.2	NR	measurements during third pass on skid path
2/13/2018	12:55-13:10	8.0	8.0	9.0	8.0	NR	measurements during forth pass on skid path
2/13/2018	13:24-13:53	8.0	7.8	9.0	7.9	NR	measurements during fifth pass on skid path

Note:
NR not recorded

Attachment H: 2018 Winter Hooking/Skidding ABS Study Field Data and Location Coordinates

Table H-4: Study Location Coordinates

Station Type	Sample Media	X_NAD 83 Zone 11 UTM	Y_NAD 83 Zone 11 UTM
Felled Tree Location	na	614790.21	5364647.53
Start of Skid Path	air	614791.12	5364647.67
Mid Point of Skid Path	air	614859.44	5364554.10
End of Skid Path	air	614883.62	5364428.79