LIBBY SUPERFUND SITE:

TECHNICAL MEMORANDUM 9

EVALUATION OF SOURCES OF LIBBY AMPHIBOLE IN INDOOR DUST IN LIBBY, MONTANA

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1.0 INTRODUCTION

Libby, Montana, is a community located near an open-pit vermiculite mine which began limited operation in the 1920's and was operated on a larger scale by the W.R. Grace Company from 1963 to 1990. Vermiculite from this mine contains varying amounts of amphibole asbestos, referred to in this report as Libby Amphibole (LA). When inhaled, LA may pose a threat to human health, increasing the risk of both cancer and non-cancer effects.

Residents in Libby may be exposed to LA from a number of sources. One source of potential concern is LA in indoor dust in homes and workplaces. LA in indoor dust may be disturbed by a wide range of normal indoor activities, causing the LA to become suspended in indoor air where it may be inhaled. Because most people spend a majority of time indoors, exposures to LA in indoor air arising from disturbance of indoor dust can be one of the most important pathways of exposure (USEPA 2003).

LA is known to occur in indoor dust at a number of locations in Libby. For example, based on a query of the Libby 2 database performed on December 1, 2005, a total of 1,149 field dust samples collected from 325 different properties in Libby had been analyzed for LA by transmission electron microscopy (TEM) as part of the Contaminant Screening Study (CSS) (CDM 2006). Of these, 104 samples (9% of the total), derived from 71 different properties (22% of the total), contained one or more LA particles, and 10 (3%) of these properties had measured LA levels that exceeded the interim trigger level for indoor dust cleanup (5,000 s/cm^2). It should be noted that most of these dust samples were analyzed with an analytical sensitivity in the range of about 300-1000 s/cm^2 (mean = 670 s/cm^2), such that LA levels lower than about 400-500 s/cm^2 would have had a low probability (< 50%) of being detected. Consequently, the actual frequency of occurrence of LA in indoor dust in Libby is likely to be higher than these statistics suggest.

Obviously, LA that occurs in indoor dust must arise from one or more other sources. Based on our current understanding of likely source materials and transport pathways, the sources that are thought to be the most likely contributors to LA in indoor dust are:

- Past or present transport of LA contaminated outdoor soil into indoor dust, either through airborne particles or by transport of soil adhering to shoes, clothing, or pets

- Past or present release of Libby vermiculite from indoor insulation (attics, walls, etc) into indoor living spaces
- Historic transport of LA on clothing, shoes, or equipment by former miners, close relatives of miners, or other highly exposed persons who live at or frequently visit the property

All three of these sources are known to occur in Libby. For example, soil contamination (either visible vermiculite or soil concentrations of 1% or greater measured by PLM-VE) have been detected at 1,179 properties, visible releases of vermiculite into indoor living spaces have been noted at 149 properties, and occupancy by a former mine worker or other highly exposed person has been established at 798 properties (CDM 2006). The degree to which each of these sources contribute to LA levels in indoor dust is expected to be highly variable between locations and as a function of time, for many reasons. For example, the releasability of LA from soil may vary depending on the weather (rain or snow cover), the releasability from indoor vermiculite may vary depending on human activity patterns (e.g., number of visits to the attic), and the amount of LA in dust may vary as a function of proximity to the source and the frequency of cleaning. In addition, limitations in analytical data (e.g., elevated sensitivities for some dust samples, difficulty in measuring LA in soil) also tend to confound the analysis of quantitative relationships. Consequently, it is not expected that precise quantitative relationships for the relative contribution of each source to indoor dust can be developed for any given property, or even for a site-wide average. However, it is possible to assess the strength of the association between the presence of a source and the likelihood of detecting an elevated level of LA in dust, as described below.

2.0 BASIC APPROACH

Detection Frequency Evaluation

If a particular source is an important contributor to LA in indoor dust, then it is expected that the detection frequency of LA in dust will tend to be higher when the source is present than when it is absent. Based on this, one means of investigating the importance of a source is to stratify locations (homes, workplaces) into two categories according to whether the source being assessed is present or absent at that home, compute the detection frequency of LA in indoor dust for each category (either on a per sample basis or a per house basis), and determine the statistical significance using the Fisher Exact Test. If the p value is small (less than 0.05), this indicates that the detection frequency observed in dust when the source is present is statistically higher that when the source is absent.

Average Concentration in Dust

If a particular source is an important contributor to LA in indoor dust, it is expected that the average concentration of LA in dust samples will tend to be higher when the source is present that when it is absent. Based on this, a second way of evaluating the importance of a source is to compute the mean concentration of LA in dust samples for locations stratified according to presence or absence of the source (either on a per sample basis or a per house basis), and evaluate the statistical significance using the Wilcoxon Rank Sum (WRS) test (also known as the Mann-Whitney rank sum test). If the p value is small (less than 0.05), this indicates that the median concentration in dust samples is higher in locations where the source is present that when the source is absent.

When selecting dust samples for use in these evaluations, care was taken to exclude any dust samples collected after an EPA-based cleanup of either soil or indoor dust, since dust samples collected after a cleanup may not reflect the contribution of the source material under evaluation. If a single dust sample had more than one set of analytical results (i.e., the same sample had been analyzed more than once), the results for that sample were pooled using the procedure described in Technical Memo 11 (USEPA 2005). The mean (average) concentration for a specified set of dust samples within one or more buildings was computed using a value of zero for non-detects (USEPA 2005). When computing the average dust concentration on a by-building (rather than by-sample) basis, the mean for each building was computed first and then the means were averaged across buildings.

Interpretation of Results

The two types of comparisons described above (frequency-based and concentration-based) should be understood to be screening-level assessments. This is because, as noted above, there is substantial variability in both sources and dust levels over time and space, and this variability may tend to mask relationships and correlations that may exist between a source and the level of contamination in the dust. In addition, in some cases, dust samples were not collected from indoor areas where contamination was believed to be present (e.g., based on the presence of visible vermiculite insulation), and this could tend to underestimate the strength of the correlation between the presence of a source and the occurrence of LA in dust by TEM. Consequently, if no relationship is detected between a particular source and LA in indoor dust, it is not correct to conclude that the data prove that the source does not contribute to LA levels in indoor dust. Rather, it is only appropriate to conclude that the magnitude of the contribution of the source to indoor dust is too small to be recognized with the available data.

3.0 EVALUATION OF OUTDOOR SOIL AS A SOURCE

Measurement of LA in outdoor soil at the Libby site is performed with polarized light microscopy using visual area estimation (PLM-VE), and each sample is assigned a semi-quantitative bin as follows:

PLM-VE Bin	Meaning
A	LA was not observed
B1	LA was observed at a level estimated to be < 0.2%
B2	LA was observed at a level estimated to be between 0.2% and 1%
C	LA was observed at a level of 1% or higher

Based on this, properties with one or more PLM-VE result for soil were stratified into two bins, as follows:

Stratum	Meaning
Soil +	One or more samples from the property was a detect (Bin B1, B2, or C)
Soil -	All soil samples from the property were non-detect (Bin A)

A query of the Libby 2 database was performed to identify all locations (properties) where PLM-VE data were available for one or more soil samples and where results for one or more TEM indoor dust samples were also available. Attachment 1 presents the query details and Table 3-1 summarizes the results. As seen, A total of 5,106 dust samples collected from 1,024 different properties were identified which met the query requirements. The detection frequency of LA in indoor dust was higher for properties with detected LA levels in soil (14%) compared to properties with soil levels that were non-detect (9%). In addition, mean LA levels in indoor dust were higher from samples collected at properties with detectable levels of asbestos in soil (799 s/cm^2) compared to those collected at properties with soils ranked as non-detect (576 s/cm^2). In both cases, these differences were statistically significant. Similar results were seen in the by-property evaluation.

Table 3-2 presents a similar analysis to Table 3-1, except that only indoor dust samples collected from entryway locations were considered. This is because it is suspected that the impact of contaminated outdoor soil may be most evident in the entryway. As seen, the pattern of results is similar to that shown in Table 3-1, with higher detection frequencies and higher average LA levels in indoor dust at locations where LA was detected in soil than in locations where LA was not detected in soil. The differences in detection frequency remain statistically significant, while the differences in average concentration were not statistically significant. This is likely due in part to the smaller number of samples (153) and properties (132) available for this test, which decreases the power of the statistical tests to recognize a difference when it exists.

Conclusion

These results support the conclusion that LA in outdoor soil at a property is a potentially important contributor to LA in indoor dust at that property.

4.0 EVALUATION OF INDOOR VERMICULITE INSULATION AS A SOURCE

Vermiculite insulation (VI) from the Libby mine is widely used in homes and businesses in Libby. As noted in Technical Memo 2 (USEPA, 2002), 74% of bulk VI samples collected from the Libby site contain detectable levels of asbestos by PLM. Based on these data, if VI is released from attics or walls into interior living spaces, it is expected that this could result in contamination of interior dust with LA. A series of evaluations were performed to investigate this relationship, as described below.

<u>Evaluation Based on Presence/Absence of Vermiculite Insulation in a Building</u>

The first evaluation performed was based on a stratification of homes based solely on the presence or absence of VI in the building. During the CSS (CDM 2006), surveys were conducted at more than 3,800 buildings, and information was collected on whether or not VI was present in the building (based mainly on visual inspection). Based on these results, each building with survey results was classified according to the following definitions:

Stratum	Meaning
VI +	Vermiculite insulation is present in one or more locations in the building
VI -	Vermiculite insulation is not known to be present in the building

A query of the Libby 2 database was performed to identify all locations (buildings) where survey data on the presence or absence of VI were available, and where results for one or more TEM indoor dust samples were also available. Attachment 1 presents the query details and Table 4-1 summarizes the results. As seen, a total of 2,787 dust samples from 802 different properties were identified which met the query requirements. In the sample-specific evaluation, the detection frequency of LA in indoor dust was similar for buildings with VI (7%) compared to buildings without VI (8%), and mean dust levels were also similar. These differences were not statistically significant. Similar results were seen in the building-specific evaluation.

Conclusion

These results support the conclusion the mere presence of VI in a home does not automatically increase the likelihood of indoor dust contamination with LA. This is perhaps not an unexpected finding, since VI that is fully enclosed and is not being released into interior living areas would not be expected to increase LA in indoor dust. The following sections focus on the potential role of unenclosed VI as a source of contamination in indoor dust.

<u>Evaluation Based on Unenclosed Vermiculite Insulation in the Attic</u>

A number of homes in Libby have vermiculite insulation in attic or ceiling spaces, and this insulation is generally unenclosed. This type of unenclosed insulation could serve as a source of contamination of indoor dust due to periodic visits to the attic by residents (bringing insulation down on shoes or clothing), or by leaking of the insulation from the ceiling to the floor below.

In order to investigate this potential source of dust contamination, the analysis described above was repeated, except that attention was focused only on the presence or absence of VI in the attic:

Stratum	Meaning
Attic +	Vermiculite insulation is present in the attic or ceiling
Attic -	Vermiculite insulation is not present in the attic or ceiling

Table 4-2 summarizes the results. As seen, there were 795 buildings where survey data were available on the presence/absence of VI in the attic and TEM data were also available for one or more indoor dust samples (total = 2,763 samples). In the sample-specific evaluation, the detection frequency of LA in indoor dust was not statistically different for buildings with VI in the attic (7%) compared to buildings without VI in the attic (8%), and concentration values of LA in indoor dust were slightly lower (but not statistically different) in buildings with attic VI than in buildings without attic VI. Similar results were seen in the building-specific evaluation.

Conclusion

These results support the conclusion the mere presence of unenclosed VI in an attic does not automatically increase the likelihood of indoor dust contamination with LA in that building. As noted above, this conclusion is perhaps not unexpected because the presence of VI in an attic does not necessarily indicate that VI is being released (e.g., via spills, leaks, or transport from resident visits to the attic) into interior living areas.

Evaluation Based on the Presence or Absence of Visible Vermiculite on a Floor

Vermiculite insulation in the walls or ceilings of a building may leak into living spaces from cracks or fixtures, especially in buildings that are not thoroughly maintained. This vermiculite is often recognizable by visual inspection of living spaces.

In the past, in order to be conservative, EPA assumed that the presence of visible vermiculite at some specific location on a floor was likely to result in widespread LA contamination of dust on that same floor, even though vermiculite might not be visible at other locations on the same floor. However, field observations suggested that this assumption was probably too conservative, and that small VAI spills confined to specific areas are unlikely to impact the surrounding areas on the same floor (CDM, 2005).

In order to evaluate this more thoroughly, USEPA collected multiple indoor dust samples at varying distances from visible vermiculite releases within a number of homes in Libby as part of Small Scale Vermiculite Removal (SSVR) efforts (CDM, 2005). In this effort, when visible vermiculite was observed on a floor, a SSVR area of at least 9 ft^2 was established around the visible release, and dust samples were collected from both within and outside of the SSVR area boundary on the same floor. Based on this, the SSVR dust samples were stratified into two bins, as follows:

Stratum	Meaning
SSVR +	Dust sample collected within the containment area established for SSVR
SSVR -	Dust sample collected outside the containment area established for SSVR, but on the same floor

These data were retrieved from the Libby 2 database as detailed in Attachment 1 and the results are presented in Table 4-3. As seen, dust data are available for 19 different floors investigated during the SSVR study. Although this data set is too small to draw firm conclusions, the detection frequency of LA does not appear to be higher, and perhaps may even be lower, for dust samples collected in close proximity to the visible vermiculite (within the SSVR containment area) than at other locations on the same floor. Likewise, average concentrations of LA tended to be lower in dusts from within the SSVR area than for elsewhere on the same floor. These results are perhaps somewhat surprising, since it is expected that LA levels in dust would tend to be highest closest to the source area, and would tend to decrease with increasing distance from the source. However, when interpreting these results, it is important to understand that dust samples collected within the SSVR boundary were intended to define a clean-up containment area, and samples were usually collected close to the outer SSVR boundary rather than in the area of highest expected contamination. In addition, it is important to note that the dust samples outside the SSVR containment area were often not collected at the same time as the sample within the SSVR containment area, and this difference in sampling date may tend to obscure any relations which may exist.

Conclusion

Based on the results presented above, the presence of visible VI on a floor of a building is not a strong predictor of the occurrence of LA contamination in a dust sample from that floor, even when dust samples were collected in close proximity to the area where VI was observed. These results support the field observation that visible VI is usually restricted to specific rooms or sub-areas, and generally not widely distributed across the entire floor (CDM 2005).

5.0 EVALUATION OF LA TRANSPORT BETWEEN FLOORS

Regardless of origin, LA contamination that is present on one floor[1] of a building might serve as a source of contamination to other floors of the same building, either through normal air circulation or through transport on shoes and clothing of residents or workers in the building. In order to evaluate the likelihood of between-floor transport of LA, two alternative approaches were followed, as described below.

<u>Approach 1</u>

In this approach, individual floors of buildings were assigned to one of two strata based on the results of the CSS survey, as follows:

Stratum	Meaning
Floor +	Visible VI is present on the floor
Floor -	Visible VI is not present on the floor

The Libby 2 database was queried to locate all floors where data were available on the presence or absence of visible VI and where one or more dust samples analyzed for LA by TEM were also available. Attachment 1 summarizes the query and the results are presented in Table 5-1. As seen, neither the detection frequency nor the average LA level are higher on floors where visible vermiculite was observed than on floors where it was not observed.

[1] For this evaluation, a "floor" is defined as basement, first floor, second floor, or attached garage, but not including attics.

Approach 2

In this approach, available data were grouped according to three different rules:

1. All buildings that had survey data on the presence of visible VI on more than 1 floor were identified, and each building was classified as having zero, one, or more than one floors with visible VI present.
2. All buildings that had TEM data on LA in indoor dust on more than 1 floor were identified, and each building was classified as having zero, one, or more than one floors with TEM detects (1 or more LA structures).
3. All buildings with either survey data on visible VI and/or TEM data on LA in indoor dust on more than 1 floor were identified, and each building was classified as having zero, one, or more than one floors with either visible VI and/or TEM detects.

The detailed queries used to identify and classify the buildings are presented in Attachment 1 and the results are summarized in Table 5-2. As seen, if LA is detected on one floor of a building, the probability that it will also be detected on one or more additional floors of the same building is relatively low (11-29%, depending on which metric of contamination is used).

Conclusion

Based on the results presented above, it is concluded that asbestos contamination as indicated either by the presence of visible VI and/or detectable LA in indoor dust is not a strong predictor of asbestos contamination on other floors or areas of the same building. This supports the strategy that EPA has selected for indoor cleanups, where each floor is evaluated independently, and presence of contamination on one floor is not assumed to indicate a need for cleanup on any other floor.

6.0 EVALUATION OF HISTORIC TRANSPORT FROM THE MINE

Another potential pathway by which indoor dust may have become contaminated with LA is by transport by individuals who lived at or visited the building and also had substantial exposure at the mine or other highly contaminated areas. As part of the CSS survey, current occupants of each building were asked if former miners, close relatives of miners, or other potentially exposed individuals lived in or frequently visited the property. Based on the response to this question, buildings were stratified according to the following definitions:

Stratum	Meaning
Historic transport +	Former miners, close relatives of miners, or other potentially exposed individuals lived in or frequently visited the building
Historic transport -	No former miners, close relatives of miners, or other potentially exposed individuals lived in or frequently visited the building

The site database was searched for all buildings where results from the CSS survey were available and where results for one or more TEM indoor dust samples were also available. Attachment 1 presents the query details and Table 6-1 summarizes the results. As seen, a total of 716 buildings were identified which met the query requirements. However, no statistically significant differences were detected in either detection frequency or average dust levels, either in the by-sample or by-building analysis.

Conclusion

These results indicate that past occupancy or frequent visitation by one or more individuals who were exposed at the mine or highly contaminated areas does not observably increase the likelihood of current indoor dust contamination with LA. This is perhaps not an unexpected finding, since indoor dust contamination that may have occurred in the past via this pathway is likely to have diminished over time due to periodic dust cleaning in the building. However, that does not imply that historic exposures due to this pathway were not of potential concern. To the contrary, the occurrence of asbestos disease in individuals in which this is the only known exposure pathway suggests that this pathway was likely to have been important in the past (ATSDR 2002a, 2002b).

7.0 DISCUSSION

The results presented above indicate that LA in indoor dust in homes and businesses in Libby may arise from several potential sources. The sources most likely to be significant under present conditions include LA contamination of outdoor soil and indoor vermiculite insulation that has been released into indoor spaces. Migration of LA in dust from one part of a floor to other parts of the same floor or to different floors does not appear to be extensive. Historic sources of contamination (e.g., dust contamination on clothing worn by former miners) were likely important in the past, but do not appear to be strongly associated with current dust levels.

8.0 REFERENCES

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Table 3-1
Evaluation of Outdoor Soil as a Source of Indoor Dust Contamination

Soil Status (a)	Dust Data (By Sample)				Dust Data (By Property)			
	Detection Frequency	Fisher Exact Test p value	Dust LA Mean ± StDev (s/cm^2)	WRS p value	Detection Frequency (b)	Fisher Exact Test p value	Dust LA Mean ± StDev (s/cm^2)	WRS p value
Soil +	306 / 2263 (14%)	< 0.001	799 ± 11,006	0.003	157 / 405 (39%)	< 0.001	641 ± 4,268	< 0.001
Soil -	248 / 2843 (9%)		576 ± 9,841		151 / 619 (24%)		274 ± 2,973	

(a) Based on PLM-VE results.
(b) Each property was ranked as a non-detect only if all dust samples were non-detect.

N Properties w/ Soil and Dust Results: 1,024
N Dust Samples from these Properties: 5,106

Table 3-2
Evaluation of Outdoor Soil as a Source of Entryway Dust† Contamination

Soil Status (a)	Dust Data (By Sample)				Dust Data (By Property)			
	Detection Frequency	Fisher Exact Test p value	Dust LA Mean ± StDev (s/cm^2)	WRS p value	Detection Frequency (b)	Fisher Exact Test p value	Dust LA Mean ± StDev (s/cm^2)	WRS p value
Soil +	7 / 45 (16%)	0.016	229 ± 679	0.122	7 / 40 (18%)	0.018	192 ± 540	0.114
Soil -	4 / 108 (4%)		39 ± 218		4 / 92 (4%)		43 ± 233	

(a) Based on PLM-VE results.
(b) Each property was ranked as a non-detect only if all dust samples were non-detect.
† Entryway dust samples were identified manually using the sample descriptor fields in the Libby 2 database, and restricted to samples where only one 1 template area (100 cm^2) was collected.

N Properties w/ Soil and Dust Results from Entryways: 132
N Entryway Dust Samples from these Properties: 153

Table 4-1
Evaluation of Vermiculate Insulation as a Source of Indoor Dust Contamination

Indoor Visible VI Status (a)	Dust Data (By Sample)				Dust Data (By Building)			
	Detection Frequency	Fisher Exact Test p value	Dust LA Mean ± StDev (s/cm^2)	WRS p value	Detection Frequency (b)	Fisher Exact Test p value	Dust LA Mean ± StDev (s/cm^2)	WRS p value
VI +	83 / 1238 (7%)	>0.5	173 ± 1,801	0.755	63 / 364 (17%)	> 0.5	268 ± 2,598	0.622
VI -	127 / 1549 (8%)		229 ± 2,406		81 / 438 (18%)		210 ± 1,328	

(a) Based on the results of CSS survey Question #16.
(b) Each building was ranked as a non-detect only if all dust samples were non-detect.

N Properties with Survey and Dust Results: 802
N Dust Samples from these Properties: 2,787

Table 4-2
Evaluation of Attic Vermiculate Insulation as a Source of Indoor Dust Contamination

Attic Status (a)	Dust Data (By Sample)				Dust Data (By Building)			
	Detection Frequency	Fisher Exact Test p value	Dust LA Mean ± StDev (s/cm^2)	WRS p value	Detection Frequency (b)	Fisher Exact Test p value	Dust LA Mean ± StDev (s/cm^2)	WRS p value
Attic +	68 / 988 (7%)	>0.5	101 ± 661	0.695	49 / 301 (16%)	> 0.5	114 ± 526	0.732
Attic -	142 / 1775 (8%)		265 ± 2,657		93 / 494 (19%)		314 ± 2,520	

(a) Based on the results of CSS survey Question #13.
(b) Each building was ranked as a non-detect only if all dust samples were non-detect.

N Properties w/ Survey and Dust Results: 795
N Dust Samples from these Properties: 2,763

Table 4-3
Evaluation of LA in Indoor Dust Within/Outside of SSVR Containment Areas

SSVR Sampling Location (a)	Dust Data (By Sample)				Dust Data (By Floor)			
	Detection Frequency	Fisher Exact Test p value	Dust LA Mean ± StDev (s/cm^2)	WRS p value	Detection Frequency (b)	Fisher Exact Test p value	Dust LA Mean ± StDev (s/cm^2)	WRS p value
SSVR +	1 / 31 (3%)	> 0.5	16 ± 87	0.803	1 / 19 (5%)	> 0.5	8 ± 37	0.932
SSVR -	8 / 57 (14%)		365 ± 1,673		6 / 18 (33%)		379 ± 1,330	

(a) SSVR properties identified by the Libby Field Team and CDM.
(b) Each building was ranked as a non-detect only if all dust samples were non-detect.

N SSVR Floors: 19
N Dust Samples collected from SSVR Floors: 88

Table 5-1
Evaluation of Between-Floor Transport of LA Based on Visible Vermiculite

Floor Visible Status (a)	Dust Data (By Sample) (b)				Dust Data (By Floor)			
	Detection Frequency	Fischer Exact Test: p value	Dust LA Mean ± StDev (s/cm^2)	WRS: p value	Detection Frequency	Fischer Exact Test: p value	Dust LA Mean ± StDev (s/cm^2)	WRS: p value
Floor +	4 / 105 (4%)	>0.50	29 ± 179	0.644	4 / 50 (8%)	>0.50	31 ± 112	0.596
Floor -	36 / 596 (6%)		93 ± 675		32 / 319 (10%)		131 ± 869	

(a) Based on the results of the CSS survey - Question #17-basement, Question #18-1st floor, Question #19-2nd floor, Question #20-garage.
(b) Dust samples manually assigned to a floor (basement, 1st floor, 2nd floor, or garage) based on the sample descriptor fields.

N Floors w/ Paired Dust & Visual Status Results: 369
N Dust Samples from Floors with Visual Status Results: 701

Table 5-2
Evaluation of Between-Floor Transport of LA Based on Visible Vermiculite and/or TEM

Metric of Contamination	Number of Buildings with Data for > 1 Floor	Number of Buildings with Contamination			Probability that if contamination is seen on 1 floor it will also be seen on another floor
		On 0 floors	On 1 Floor	On > 1 Floor	
Visible VI (a)	904	815	79	10	11%
LA Detect in Dust by TEM (b)	480	387	66	27	29%
Either visible VI and/or LA detect by TEM (c)	1,097	887	168	42	20%

(a) Based on survey results for potential living areas (basement, 1st floor, 2nd floor, attached garage)
(b) Based on Pooled TEM LA Dust Loading from potential living areas (basement, 1st floor, 2nd floor, 3rd floor, attached garage)
(c) Building ranked as + if either the LA dust loading was detect or the survey reported visual VI

Table 6-1
Evaluation of Historical Transport as a Source of Indoor Dust Contamination

Historic Transport Status (a)	Dust Data (By Sample)				Dust Data (By Building)			
	Detection Frequency	Fisher Exact Test p value	Dust LA Mean ± StDev (s/cm^2)	WRS: p value	Detection Frequency (b)	Fisher Exact Test p value	Dust LA Mean ± StDev (s/cm^2)	WRS: p value
Historic Transport +	82 / 1006 (8%)	0.31	319 ± 3,096	0.390	59 / 295 (20%)	0.34	275 ± 1,589	0.334
Historic Transport -	117 / 1544 (8%)		158 ± 1,495		78 / 421 (19%)		254 ± 2,413	

(a) Based on the results of CSS survey Question #2.
(b) Each property was ranked as a non-detect only if all dust samples were non-detect.

N Buildings with Valid Answers to CSS Question #2: 716
N Dust Samples from these Buildings: 2,550

ATTACHMENT 1

GENERAL INFORMATION ON DATA REDUCTION STRATEGIES AND DETAILED QUERY INFORMATION

(provided electronically)