Appendix B: Quality Assurance/Quality Control

Quality Assurance/Quality Control (QA/QC)
QA/QC was performed on several levels. Aeolus, Inc. served as a QA/QC advisor and designed a plan that assessed repeatability of elutriator preparations within EMS, Inc. Repeatability of TEM microscopy relative to asbestos structure identification and counting was also assessed between EMS and UAS. The QA/QC plan is described in Appendix C.

Follow-up QA/QC and laboratory analysis using other sample preparation methods were also performed by UAS, Inc. These results are also described below.

Relative percent difference is used to calculate the precision from duplicate measurements. The formula for calculating the Relative Percent Difference is RPD = 100* Absolute Value(X_1-X_2)/((X_1+X_2)/2) where X_1 and X_2 are the two measurements being compared. Table B-1 is a compilation of the six elutriator duplicate measurements, which are an indication of the reproducibility of sample analysis from the point of splitting the sample at UAS laboratories through the tumbling, air entrainment, and elutriator process and the microscopy at EMS laboratory.

Table B-1: Relative Percent Differences of Elutriator Duplicate Samples Within EMS Laboratory

Sample #	Chrysotile Structures			Amphibole Structures		
	Concentration (s/g PM_{10})			Concentration (s/g PM_{10})		
	Duplicate 1	Duplicate 2	RPD	Duplicate 1	Duplicate 2	RPD
WH-9	3.0E+06	2.0E+06	40	2.0E+06	7.0E+06	111
WH-7	3.9E+07	2.1E+07	61	5.9E+06	4.0E+06	39
WH-3	1.3E+07	5.9E+06	74	9.9E+05	3.0E+06	99
OSB-3	2.9E+06	4.0E+06	32	5.4E+07	3.8E+07	36
IBSP-4S	0.0E+00	9.9E+05	200 [a]	7.9E+06	3.0E+06	90
GPB-12	0.0E+00	0.0E+00	0	7.0E+06	0.0E+00	200 [b]
Mean	9.7E+06	5.6E+06	53 [c]	1.3E+07	9.1E+06	36 [c]
Median	2.9E+06	3.0E+06	2 [d]	6.4E+06	3.5E+06	59 [d]

[a] This represents the maximum possible RPD value; in this case, the difference is between one structure counted and zero structures counted.
[b] This represents the maximum possible RPD value; in this case, the difference is between seven structures counted and zero structures counted.
[c] Calculated from mean of all duplicates.
[d] Calculated from median of all duplicates.

The compilation in Table B-1 indicates that the average difference for duplicates of any single sample is approximately 50%. In general, the differences are less pronounced at higher concentrations. The table also indicates that the differences do not appear to be systematic because they are in both directions (higher and lower concentrations) and are across results for both chrysotile and amphibole structures. The results indicate that the laboratory operated with good precision. In any case, the RPD is a measure of precision of individual samples. This study did not rely on individual samples, but rather, 12 samples from each site. The precision of the method in terms of relative error is about 50%.

Table B-2 is a compilation of the 10 replicate laboratory existing grid analyses. Some TEM grids were sent from EMS to UAS for microscopy re-analysis. These replicate analyses are an indication of the repeatability of TEM microscopy relative to asbestos structure identification and counting.

Table B-2: Relative Percent Differences of Existing Grid Analyses across Laboratories

		Chrysotile Structures			Amphibole Structures		
		Concentration (s/g PM_{10})			Concentration (s/g PM_{10})		
Sample #	**Laboratories**	**Duplicate 1**	**Duplicate 2**	**RPD**	**Duplicate 1**	**Duplicate 2**	**RPD**
WH-9B	EMS & UAS	3.0E+06	5.0E+06	50	2.0E+06	8.0E+06	120
WH-9A	EMS & UAS	2.0E+06	1.0E+06	65	7.0E+06	7.1E+06	2
WH-7B	EMS & UAS	3.9E+07	6.9E+07	55	5.9E+06	1.5E+07	88
WH-7A	EMS & UAS	2.1E+07	3.9E+07	60	4.0E+06	1.2E+07	101
WH-3B	EMS & UAS	1.3E+07	2.3E+07	58	9.9E+05	4.7E+06	130
WH-3A	EMS & UAS	5.9E+06	2.4E+07	122	3.0E+06	2.7E+06	8
OSB-3B	EMS & UAS	2.9E+06	1.1E+07	115	5.4E+07	1.4E+08	88
OSB-3A	EMS & UAS	4.0E+06	2.2E+07	138	3.8E+07	8.4E+07	77
IBSP-05S	EMS & UAS	0.0E+00	1.0E+06	200 [a]	0.0E+00	4.0E+06	200 [b]
OSB-01A	EMS & UAS	5.0E+06	1.2E+07	84	1.9E+07	7.8E+07	121
Mean		9.6E+06	2.1E+07	74 [c]	1.3E+07	3.6E+07	91 [c]
Median		4.5E+06	1.7E+07	116 [d]	4.9E+06	1.0E+07	68 [d]

[a] This represents the maximum possible RPD value; in this case, the difference is between one structure counted and zero structures counted.

[b] This represents the maximum possible RPD value; in this case, the difference is between four structures counted and zero structures counted.

[c] Calculated from mean of all duplicates.

[d] Calculated from median of all duplicates.

The compilation in Table B-2 indicates that the average difference for replicates of any single sample ranges from 74 - 91%. The table also indicates that the differences do not appear to be systematic because they are in both directions (higher and lower concentrations) and are across results for both chrysotile and amphibole structures. Note in the discussion below that the laboratories did not always follow the same stopping rules, and therefore, there is no way to judge the absolute accuracy of the counts from either laboratory. However, both laboratories are accredited by the National Institute of Standards and Technology (NIST) National Voluntary Laboratory Accreditation Program (NVLAP). Therefore, the source of the differences may be due to other issues.

Some of the grid replicate counting differences may be due to random error, in that the laboratories chose grid openings randomly and different grid openings are likely to have different numbers of fibers. It also appears that EMS Laboratories did not follow the stopping rules contained in the Superfund/Elutriator protocol and continued to analyze grids to reach the

full analytical limits regardless of how many structures were counted. This does not indicate that the results are compromised, but it does explain some of the differences in counting between laboratories. UAS followed the protocol stopping rules until asked by GLCEEH to follow the EMS manner of counting grids for the last three replicates. In terms of this study, the fact that EMS was consistent in the number of grids counted should indicate consistency in the results used for this study.

Another source of differences between laboratories is that no check samples or verified analyses (analyses to ensure that laboratories are counting complex structures in the same manner) were run between laboratories before analysis of the replicate samples. It is not known whether shipping, handling, or longevity of grids can introduce differences between laboratories. Both laboratories appeared to follow appropriate care in sample handling and analysis.

Other Analyses

UAS, Inc. performed several other types of analyses on duplicates of the sand samples collected for this study. UAS analyzed 10 duplicate samples according to Method for the Determination of Asbestos in Bulk Building Materials[1] discussed earlier in this report. The results for all 10 samples were non-detect (Appendix.C, UAS page 65-66).

UAS also analyzed 10 samples with a method that involves placing 10 grams of sand in water, sonicating the water, and drawing the water through a filter that is analyzed by TEM. The method and results are described in Appendix C, UAS page 63. The results are also presented below.

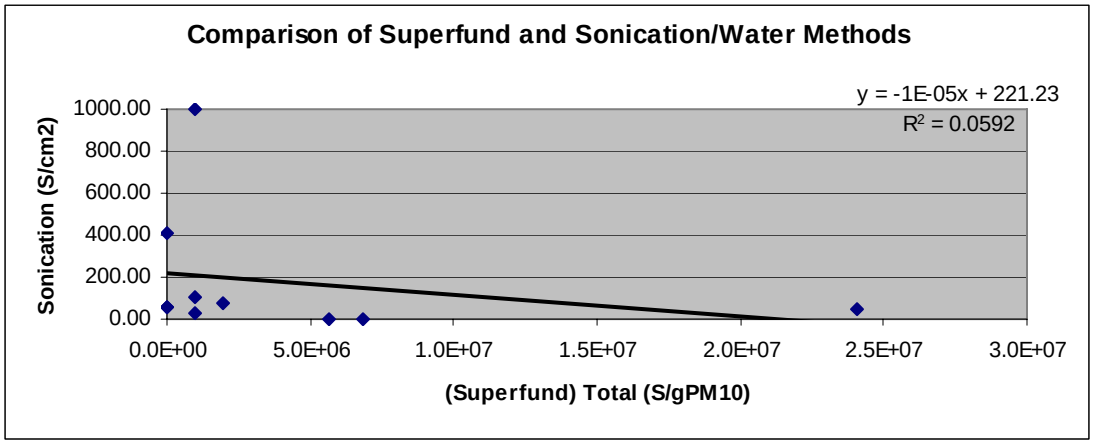
[1] U.S. EPA Method for Determination of Asbestos in Bulk Building Materials, U.S. EPA/600/R-93-116 (7/93 Edition).

Table B-3: Superfund/Elutriator and Sonication /Water Results

		Concentrations of Chrysotile Structures				Concentrations of Amphibole Structures				Concentrations of Total Asbestos Structures					Sonication/ Water Method Results	
Sample Number	Analytical Sensi-tivity	Total Protocol Structures	Fraction Long Protocol	7402 Structures	Total Long Structures	Total Protocol Structures	Fraction Long Protocol	7402 Structures	Total Long Structures	Total Protocol Structures	Fraction Long Protocol	7402 Structures	Total Long Structures		Concen-tration	
	(s/g_{PM10})	(s/g_{PM10})	(%)	(s/g_{PM10})	(s/g_{PM10})	(s/g_{PM10})	(%)	(s/g_{PM10})	(s/g_{PM10})	(s/g_{PM10})	(%)	(s/g_{PM10})	(s/g_{PM10})	Fiber types	(S/cm2)	Fiber Types
IBSP-06S	***9.9E+05***												0.0E+00		409.09	C-27
HPB-11A	***1.0E+06***												0.0E+00		60.61	C-4
GPB-09A	***1.0E+06***												0.0E+00		60.61	C-2, A-2
HPB-04A	9.7E+05			9.7E+05	9.7E+05							9.7E+05	9.7E+05		1000.00	C-66
GPB-03A	9.7E+05	9.7E+05	100%		9.7E+05					9.7E+05	100%		9.7E+05		30.30	C-2
OSB-10A	1.0E+06	1.0E+06	100%	1.0E+06	1.0E+06					1.0E+06	100%	1.0E+06	1.0E+06		106.06	C-6, A-1
IBSP-15S	9.8E+05					9.8E+05	100%	2.0E+06	2.0E+06	9.8E+05	100%	2.0E+06	2.0E+06	A, Ac	75.76	C-3, A-2
WH-04A	9.4E+05	4.7E+06	100%	9.4E+05	4.7E+06	9.4E+05	100%	9.4E+05	9.4E+05	5.6E+06	100%	1.9E+06	5.6E+06	A	(LOD) 0.00	
WH-10A	9.7E+05	6.8E+06	57%	3.9E+06	6.8E+06					6.8E+06	57%	3.9E+06	6.8E+06		(LOD) 0.00	
OSB-01A	1.0E+06	4.0E+06	50%	4.0E+06	5.0E+06	1.7E+07	24%	1.5E+07	1.9E+07	2.1E+07	29%	1.9E+07	2.4E+07	A-8, Ac-4, T-7	45.45	C-3

A regression plot (Figure B-1) indicates a negative correlation between microscopy results after sample preparation by the sonication/water method and the Superfund/Elutriator method. This indicates that these two sample preparation methods are not compatible because they agitate the sample and capture asbestos fibers onto filters in different manners. The Superfund/Elutriator method relies on air flow to aggressively agitate and separate asbestos structures from the sample, which is more consistent with the inhalation route of exposure.

Figure B-1:



Validation of the Emissions Model

A limited amount of PM_{10} emissions data was available from personal air sampling results collected during the pilot study for sand processing.[2] In order to obtain an approximate comparison of the modeled PM_{10} emissions and box model to field data, calculations were made of the ratio of the sand handled to PM_{10} emissions. The estimated amount of sand handled during the screening study was compared to the lowest and highest concentrations of PM_{10} collected on personal air samples on pilot study workers. It was not possible to create a box model for these workers because there was insufficient information about their tasks and movements, as well as diffuse sources of emissions. Therefore, the calculated field data ratio relies on an estimate of sand handled per hour, without estimating the size of the work area. The mass of sand (11,928 kg) is estimated from the mass of a 10-yd^3 test pits. Ten test pits were excavated over a three-day period and the sand in each test pit was moved by backhoe to portable scales, then to a screening plant. The sand went through three screens, several short conveyors, and transport back to the stockpile. The estimation assumes this operation was equivalent to one test pit handled per hour over the course of an eight-hour day.

Table B-4: PM_{10} Emissions Ratios, Field versus Estimated

	Amount of sand handled/hour (estimated) (kg)		PM_{10} Concentration (mg/m3)	Ratio of Sand Handled/hour to PM_{10} (kg/hr)/(mg/m3)
Pilot Sand Screening Study	11,928	Lowest concentration personal air sample	0.13	91,754
	11,928	Highest concentration personal air sample	1.06	11,253
Estimated by Emissions Model (1 x 1 m box)	50		0.0017	29,175
	100		0.0034	29,175

The ratio of sand handled to PM_{10} emissions from the field data ranges from 11,253 to 91,754 (kg/hr)/(mg/m3) for the pilot study. The ratio of sand handled to estimated PM_{10} emissions from the emissions model is 29,175 (kg/hr)/(mg/m3), which falls within the field data range. This indicates that the PM_{10} emissions and box model is relatively consistent with measured PM_{10} emissions from aggressive sand handling.

[2] Hanson Engineers, Inc., Report of Findings: Pilot Study for Sand Processing, Illinois Beach State Park, Volumes I and II, February 2000.