QUALITY ASSURANCE PROJECT PLAN:

EVALUATION OF AN ALTERNATIVE ASBESTOS CONTROL METHOD FOR BUILDING DEMOLITION

Prepared for:

Mr. Glenn M. Shaul
Task Order Manager
U.S. EPA, Office of Research & Development
National Risk Management Research Laboratory
26 West Martin Luther King Drive
Cincinnati, OH 45268

Prepared by:

Environmental Quality Management, Inc.
1800 Carillon Boulevard
Cincinnati, OH 45240

Contract No. 68-C-00-186
Task Order No. 0019

and

U.S. Environmental Protection Agency
QAPP Technical Development Team

A1 QUALITY ASSURANCE PROJECT PLAN

APPROVAL SHEET

EVALUATION OF AN ALTERNATIVE ASBESTOS CONTROL METHOD FOR BUILDING DEMOLITION

Contract No. 68-C-00-186
Task Order No. 0019

John R. Kominsky, Project Manager — Date
Environmental Quality Management, Inc., Cincinnati, OH

Jackie Doan, Quality Assurance Manager — Date
Environmental Quality Management, Inc., Cincinnati, OH

Lauren Drees, Quality Assurance Officer — Date
ORD, NRMRL, U.S. EPA

Glenn M. Shaul, Task Order Manager — Date
ORD, NRMRL, U.S. EPA

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A3 ACKNOWLEDGEMENT AND DISTRIBUTION LIST

A3.1 Acknowledgement

The following individuals participated in preparation of this Quality Assurance Project Plan.

U.S. EPA QAPP Technical Development Team:

Keith Barnett, OAQPS
Lee Hoffman, OSW
Ron Rutherford, OECA
Brad Venner, NEIC
David Eppler, Region 6
Jim Konz, OSRTI
Glenn Shaul, NRMRL
Roger Wilmoth, NRMRL
Mark Hansen, Region 6
Mark Maddaloni, Region 2
John Smith, OPPT
Julie Wroble, Region 10

U.S. EPA Resource Members:

Charlotte Bertrand, OPEI
Elvia Evering, Region 6
Todd Martin, NRMRL
David Cozzie, OAQPS
Chris Kaczmarek, OGC
Steve Schanamann, OIG
Becky Dolph, Region 7
Marcus Kantz, Region 2
Lynn Slugantz, Region 7

State of Arkansas Resource Members:

Lloyd Huntington, ADEQ
Torrence Thrower, ADEQ

Contractor Project Team:

Mike Beard, RTI International, Research Triangle Park, NC
David Cox, QuanTech, Inc., Arlington, VA
Owen Crankshaw, RTI International, Research Triangle Park, NC
John Harris, Lab/Cor, Inc., Seattle, WA
John Kominsky, Environmental Quality Management, Inc., Cincinnati, OH
James Millette, MVA Scientific Consultants, Inc., Duluth, GA
Jeanne Orr, Reservoirs Environmental, Inc., Denver, CO

A3.2 Distribution List

Same individuals listed in Section A3.1 with the addition of the following:

Lauren Drees, NRMRL
David Gray, U.S. EPA, Region 6
Sandy Sanders, Fort Chaffee Re-Development Authority

A4 PROJECT TASK/ORGANIZATION

A4.1 Project Organization

The U.S. EPA's Office of Research and Development (ORD) and U.S. EPA Region 6 are cooperatively conducting this research project. Environmental Quality Management, Inc. (EQ) is the prime contractor on the project and will have overall responsibility to ensure that the project is conducted in accordance with the approved Quality Assurance Project Plan (QAPP). MVA Scientific Consultants, Inc. (MVA), Reservoirs Environmental, Inc. (REI), and Lab/Cor, Inc. will perform the primary laboratory analyses of the samples. RTI International will perform the independent quality assurance analyses of the samples. QuanTech Inc. will assist EQ in preparing the study design and will perform the statistical analysis of the data.

The overall project organization is presented in Figure A-1. It graphically shows the functional organization structure and lines of communication for this project. The project structure along with the technical personnel selections are designed to provide efficient management and a high level of technical competence to accomplish this research project. The roles and responsibilities of key project personnel are summarized in Table A-1.

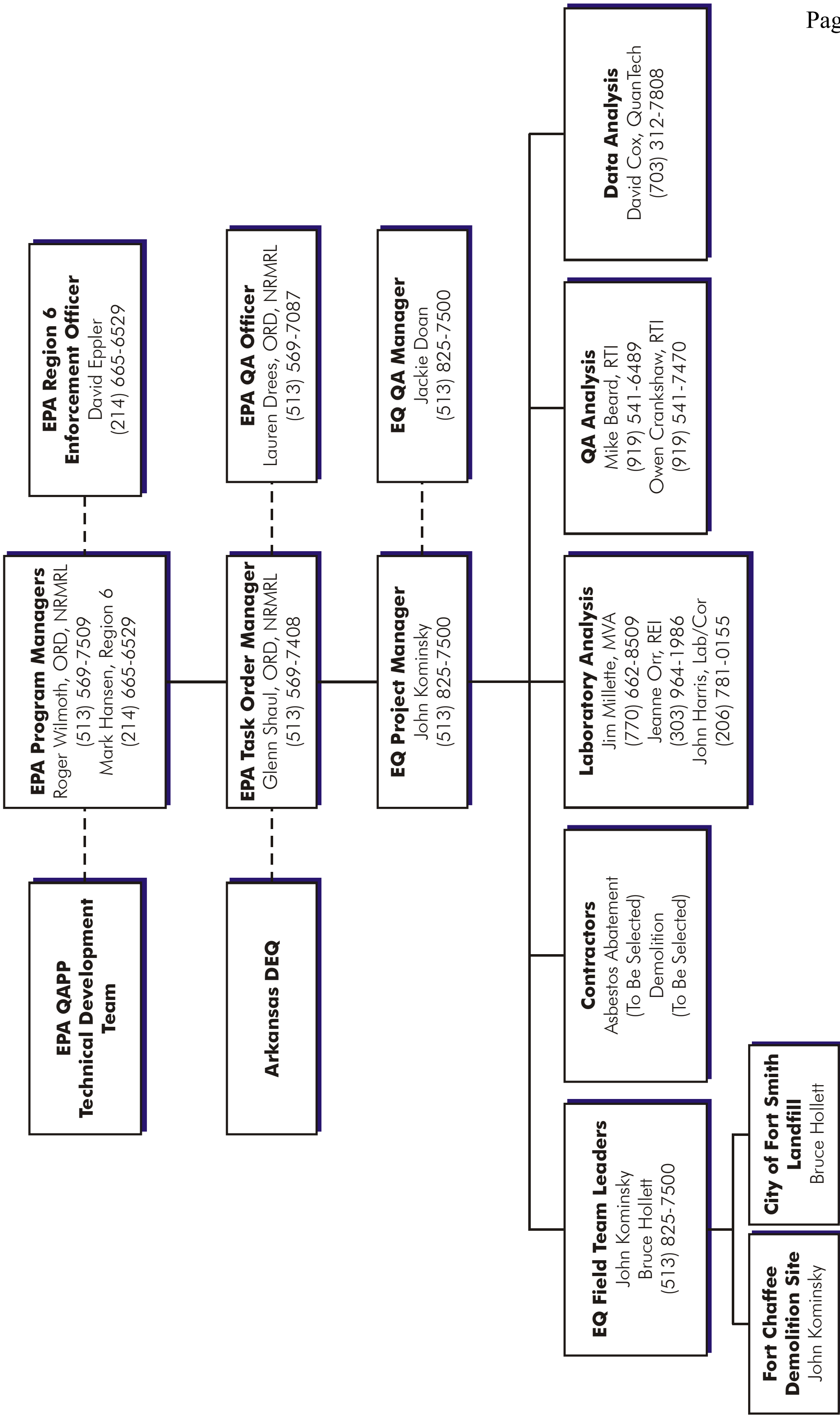

Figure A-1. Project Organization Structure

Table A-1. Roles and Responsibilities of Key Project Personnel

Personnel	Role and Responsibility
Roger Wilmoth, U.S. EPA, ORD, NRMRL	*Co-Program Managers*, will have overall administrative and technical responsibility for this project.
Mark Hansen, U.S EPA, Region 6	
Glenn Shaul, U.S. EPA, ORD, NRMRL	*Task Order Manager (TOM),* will direct the project and ensure that it is proceeding on schedule and within budget. Point of contact for EQ.
David Eppler, U.S EPA, Region 6	*On-Site Enforcement Officer*, will provide technical direction (as needed) to the EPA TOM. Point of contact for Fort Chaffee ReDevelopment Authority.
Lauren Drees, U.S. EPA, ORD, NRMRL	*QA Officer*, will provide QA oversight to ensure that the planning and plan implementation are in accordance with the approved QAPP. In addition, ORD's QA Officer will oversee RTI's audits of MVA, REI, and Lab/Cor.
John Kominsky, EQ	*Project Manager*, will have overall administrative and technical responsibility for EQ and its sub-contractors to ensure that data collection and analysis and the technical report meet the planned study objectives.
Jackie Doan, EQ	*QA Manager*, will review and approve the QAPP. Provide overall QA oversight and coordination to ensure acceptable data collection, recovery, and analysis, as well as data validation.
David Cox, QuanTech	*Statistician*, will assist EQ's Project Manager with developing the study designns, and perform the statistical analysis of the data.
James Millette, MVA	*Microscopist,* will provide primary laboratory analysis of asbestos air samples using transmission electron microscopy (TEM) and phase contrast microscopy (PCM).
Jeanne Orr, REI	*Microscopist,* will provide primary laboratory analysis of asbestos soil and water samples (TEM). REI staff will provide laboratory analysis of air and soil samples for inorganic lead.
John Harris, Lab/Cor	*Microscopist,* will generate and provide the primary laboratory asbestos analysis of the soil elutriation samples (TEM).
Mike Beard, RTI Owen Crankshaw, RTI	*Microscopist*, will direct/provide independent quality assurance (QA) analysis of selected air and soil samples (TEM) collected for asbestos. Owen Crankshaw will also perform an on-site laboratory audit of MVA, REI, and Lab/Cor.
Arkansas Department of Environmental Quality (DEQ)	*Inspector,* will assure that NESHAP requirements are followed; empowered to stop work if wind conditions or visible emissions or adequately wet requirements in QAPP are not met.
QAPP Technical Development Team	Participated in development of the QAPP.
Abatement and Demolition Contractors (To be Identified)	Will perform asbestos abatement of NESHAP Building and demolition of both the NESHAP and Alternative Method Buildings.
EQ Field Team Leaders (J. Kominsky and B. Hollett)	Will direct and oversee field sampling efforts.

A5 PROBLEM DEFINITION/BACKGROUND

A5.1 Background

The Clean Air Act provides the EPA with the authority to promulgate a "*work practice standard*" if it is not feasible to establish an emission standard. Under Section 112 of the Clean Air Act, asbestos is determined to be a hazardous air pollutant and is regulated under EPA's asbestos National Emission Standard for Hazardous Air Pollutants (NESHAP), 40 CFR Part 61, Subpart M.

The asbestos NESHAP (*a work practice standard*) requires the removal of all regulated asbestos-containing material (RACM)[1] prior to demolition of the facility. The asbestos NESHAP specifies emission control procedures [§61.145(c)] and waste disposal requirements [§61.150] that must be followed during demolition of a facility that contains asbestos above the threshold amount.[2] Section §61.150 of the asbestos NESHAP requires owners to "discharge no visible emissions to the outside air" during demolition and renovation activities. If a facility is being demolished because it is structurally unsound and is in danger of imminent collapse, RACM is not removed prior to demolition, but the RACM must be kept adequately wet during demolition. All of the contaminated debris must be kept adequately wet until disposal and must be disposed of as ACM.

The EPA will perform a controlled demonstration to compare the relative environmental impacts of the Alternative Asbestos Control Method to the NESHAP method. These data would then be used to help EPA determine whether it is appropriate to include an alternate method in the current asbestos regulations contained in 40 CFR part 61 subpart M. The alternative method, if determined to be environmentally acceptable but less costly than the current regulations, may

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1 Under asbestos NESHAP, RACM means friable asbestos material; Category I non-friable ACM that has become friable; or Category II non-friable ACM that has a high probability of becoming or has become crumbled, pulverized, or reduced to powder by forces expected to act on the material in the course of demolition.

2 Asbestos NESHAP [§61.145(a)] requires that if the following amounts of RACM are present in a facility, these materials must be removed prior to demolition: (1) At least 260 linear feet on pipes; or (2) at least 160 square feet on other facility components; or (3) where the amount of RACM on pipes or other components could not be measured before stripping, a total of at least 35 cubic feet from all facility components in a facility being demolished.

have the benefit of allowing municipalities to demolish abandoned buildings that otherwise would remain standing until they were in danger of imminent collapse.

The Alternative Asbestos Control Method requires that certain RACM (such as thermal system insulation and fireproofing) be removed before demolition in accordance with the asbestos NESHAP; other RACM (such as wallboard joint compound, resilient flooring/mastic, glazing compound) may remain in place. The alternative method varies from the existing Asbestos NESHAP in the use of an amended-water wetting process, type of demolition equipment, and demolition techniques. Once the required RACM is removed, the demolition proceeds using amended water suppression before, during, and after demolition to trap asbestos fibers and minimize the potential release to the air. The RACM is less likely to become friable when the wetting process and demolition techniques specified in the alternative method are used. Wastewater generated during the demolition is collected and filtered, and all debris is disposed of as asbestos-containing waste. Soil in the affected area is excavated and disposed as asbestos-containing waste. Appendix A contains the Alternative Asbestos Control Method that was developed by EPA Region 6, the EPA ORD, and with input from the EPA QAPP Technical Development Team.

The purpose of this research project is to compare the environmental and cost-effectiveness of the Alternative Asbestos Control Method vs. the current Asbestos NESHAP method through a side-by-side comparison of the demolition of buildings that are architecturally identical in composition and structure. This research project will assist EPA in comparing existing demolition practices of the Asbestos NESHAP with potentially more cost-effective demolition practices.

A5.2 Objective

The goal of this research study is to compare the effectiveness of the Alternative Asbestos Control Method to the current asbestos NESHAP demolition practice on buildings that are architecturally identical. This means that the environmental releases of asbestos to the air and to the soil as measured by their respective concentrations are not greater in the case of the Alternative Method than those of the NESHAP Method. In addition, the cost of the Alternative Method must be less than the NESHAP Method for the Alternative to be attractive. All of the data collected will be evaluated and considered, as appropriate, to make this comparison.

Emissions must be inferred from measured concentrations in receptors (air, soil, water, dust, and personal monitoring). Because of the complex nature of the potential emissions from building demolition, it is difficult to state in advance precisely how these data will be evaluated, but all the data and observations obtained will be used to make the comparison between the two methods.

A5.2.1 Primary Objectives

1. To determine if the **airborne asbestos (TEM) concentrations** from the Alternative Method are statistically equal to or less than the NESHAP Method.

2. To determine if the **post-excavation asbestos concentrations** in the soil from the Alternative Method are statistically equal to or less than the post-demolition NESHAP Method. The Alternative Method requires soil excavation following demolition and the NESHAP Method does not.

3. To determine if the **Alternative Method is more cost-effective** than the NESHAP Method considering all costs, including disposal of all asbestos-contaminated materials and soils, and projected costs for enforcement.

A5.2.2 Secondary Objectives

The following secondary objectives will provide additional information to further characterize the interrelationships among several multimedia parameters to enhance the understanding of the process and to further the science. These data will also be considered in a holistic sense in assessing the comparability of the two demolition methods:

AIR

1. To determine **background asbestos concentrations (TEM)** prior to the NESHAP Abatement and again prior to the Alternative Demolition.

2. To determine if the **airborne fiber (PCM) concentrations** from the Alternative Method are statistically equal to or less than the concentrations from the NESHAP Method.

3. To document **visible emissions** during both demolitions.

4. If wind conditions allow, to determine if the **airborne asbestos concentrations downwind are statistically greater than the upwind concentrations** for the Alternative Method.

5. If wind conditions allow, to determine if the **airborne asbestos concentrations downwind are statistically greater than the upwind concentrations** for the NESHAP Method.

DUST

6. To determine if the **asbestos concentrations in the settled dust (TEM)** from the Alternative Method are statistically equal to or less than the concentrations from the NESHAP Method.

WORKER

7. To determine if **worker fiber exposure concentrations (PCM)** from the Alternative Method are statistically different than the concentrations from the NESHAP Method.

8. To determine if **worker asbestos exposure concentrations (TEM)** from the Alternative Method are statistically different than the concentrations from the NESHAP Method.

ACTIVITY

9. To document **worker asbestos exposure concentrations (TEM)** for individuals that are maintaining the perimeter air monitoring network.

SOIL

10. To determine if the **asbestos concentration in the post-excavation soil** from the Alternative Method is statistically equal to or less than the pre-demolition asbestos concentration.

11. To determine if the **asbestos concentration in the post-demolition soil** from the NESHAP Method is statistically equal to or less than the pre-demolition asbestos concentration.

12. To determine if **asbestos concentration in the post-excavation soil is statistically different than the concentration in the post-demolition soils** from the Alternative Method.

13. To determine if **asbestos concentrations from elutriator tests on the post-excavation soils from the Alternative Method are statistically equal to or less than the concentrations from the post-demolition** NESHAP Method.

14. To determine if **asbestos concentrations from elutriator tests on the post-excavation soils from the Alternative Method are statistically equal to or less than the pre-demolition** concentrations.

15. To determine if **asbestos concentrations from elutriator tests on the post-demolition soils from the NESHAP Method are statistically equal to or less than the pre-demolition** concentrations.

16. To determine if **asbestos concentrations from elutriator tests on the post-excavation soil are significantly different than the concentrations from tests on the post-demolition soil** from the Alternative Method.

WATER

17. To measure the **asbestos concentrations in the water applied** to control emissions from both the Alternative and NESHAP Methods and to measure the **asbestos concentrations in collected water** for both processes during demolition activities.

LANDFILL

18. To determine **background airborne asbestos concentrations (TEM) prior to landfilling** of the NESHAP Building debris and again prior to landfilling of the Alternative Method Building debris.

19. To determine if the **airborne asbestos concentrations at the landfill (TEM) during disposal** of the Alternative Method debris are statistically equal to or less than the concentrations during disposal of the NESHAP Method debris.

20. To determine **airborne asbestos concentrations at the landfill (TEM) during disposal** of the asbestos-containing materials (ACM) removed prior to demolition of the NESHAP Building.

21. To determine if **landfill worker fiber exposure concentrations (PCM)** from the Alternative Method are statistically different from the NESHAP Method.

22. To determine if **landfill worker asbestos exposure concentrations (TEM**) from the Alternative Method are statistically different from the NESHAP Method.

TIME

23. To document the **time required for all activities** related to the demolition by the Alternative Method and for the NESHAP Method, including abatement.

MODELING

24. To collect **additional asbestos, fiber, and dust data** necessary for potential future air dispersion modeling efforts.

Regulatory Requirements for Lead:

In addition, worker exposure sampling will be conducted for lead in accordance with 29 CFR §1926.62, which applies to all abatement, demolition, and landfilling activities involved in this study.

A6 PROJECT/TASK DESCRIPTION

A6.1 Technical Approach

The project will gather data on the Asbestos Alternative Control Method's ability to prevent or minimize the release of asbestos fibers during demolition and disposal of a building containing RACM versus a building abated and demolished in accordance with the Asbestos NESHAP. These data would then be used by EPA to determine if it is appropriate to include an alternate method in the current asbestos regulations contained in 40 CFR Part 61 Subpart M. All of the data collected will be evaluated and considered, as appropriate, to support decisions about the future use of the Alternative Method.

The buildings are located at the Fort Chaffee Redevelopment Authority in Fort Smith, Arkansas (Figure A-2). The NESHAP (#3602) and Alternative Method (#3607) Buildings are shown in Figure A-2. In addition, two adjacent buildings were surveyed and the results were similar but are not presented in this QAPP because the buildings are not part of the study.

The demolition site is in a remote, secure location to ensure no public exposure. There are no private residences within a radial distance of one mile from the study buildings. The nearest residence is approximately two miles from the demolition site. The buildings have a clearance of approximately 1,000 linear feet from the nearest occupied military building on the eastern side, and greater than 1,400 linear feet in all other directions.

These 1940-era buildings are architecturally identical both in composition and structure (Figures A-3 through A-5), which is ideal for the testing and comparative evaluation of the Alternative Method versus the Asbestos NESHAP Method. The building footprint is approximately 4,500 square feet (30 feet by 150 feet). The buildings are wood frame construction with wood clapboard exterior siding and asphalt shingle roofs. The interior finish is gypsum wallboard on both the ceiling and walls, and associated painted millwork. Resilient floor tile (9 inch by 9 inch) is present in all areas excluding the bathrooms, which is resilient sheet vinyl. The building has a concrete pier and wooden beam foundation system. The buildings utilized window unit air conditioners with heating formerly supplied by radiant heaters. Forced hot water for the radiant heat was supplied by a central steam plant located elsewhere in the complex.

Figure A-2. Aerial view of project location at Fort Chaffee. Buildings selected for demolition are #3602 (NESHAP Method) and #3607 (Alternative Method).

Figure A-3. (Top) Exterior view of Building #3602 (NESHAP Method) and (Bottom) #3607 (Alternative Method). Dimensions: 30-feet by 150-feet.

Figure A-4. Interior view of Building #3602. Interior finishes are gypsum wallboard (ceiling and walls) and 9- by 9-inch resilient floor tile.

Figure A-5. Interior view of Building #3607. Interior finishes are gypsum wallboard (ceiling and walls) and 9- by 9-inch resilient floor tile.

All asbestos-containing thermal system insulation on the steam pipes associated with these buildings has been previously abated.

The demolition debris will be transported to City of Fort Smith's Subtitle "D" landfill. The landfill is owned and operated by the City of Fort Smith. It is located at 5900 Commerce Road in Fort Smith, which is approximately 7 miles southwest of the demolition site.

A6.1.1 Pre-Demolition Inspection of Buildings

A6.1.1.1 Asbestos Inspection of Buildings

A comprehensive pre-demolition inspection was conducted in accordance with the Asbestos Hazard Emergency Response Act (40 CFR §763) to identify the type, quantity, location, and condition of RACM in the buildings [§61.145(a)] (Kominsky 2005; Smith 2005). The inspection was conducted by a State of Arkansas Department of Environmental Quality (ADEQ) licensed Asbestos Abatement Consultant. The inspection data will be used to determine the pre-demolition asbestos abatement plan for these buildings.

The samples were analyzed for asbestos content by using polarized light microscopy (PLM) and dispersion staining in accordance with EPA's "*Method for the Determination of Asbestos in Bulk Building Materials*" (EPA/600/R-93/116, July 1993). Gravimetric reductions followed by TEM analyses (as specified in EPA/600/R-93/116, July 1993) were performed on wallboard joint compound, resilient floor tile, and window glazing compound samples. For materials composed of distinct layers (e.g., wallboard joint compound, Figure A-6) or two or more distinct building materials (e.g., shingle and roofing felt), each layer or distinct building material was treated as a discrete sample. The layers or materials were separated and analyzed individually. The laboratory reported a single value for each material or discrete layer. In addition, the laboratory reported a composite value for wallboard joint compound samples. Composite values were calculated using estimates of the quantity of each layer in the sub-sample as determined by measuring to a distance as wide as the seam (Figure A-6, d1) on both sides of the seam (Figure A-6, d2). That is, the sample used to estimate the quantity of each layer is represented by d2 in Figure A-6.

Figure A-6. Section of ½-inch gypsum wallboard showing a multi-layered joint interval. Wallboard was obtained from Building #3607 at Fort Chaffee.

Table A-2 summarizes the results of the building material samples collected from the NESHAP Method (#3602) and Alternative Method (#3607) Buildings.

Table A-2. Asbestos Content of Building Materials Based on PLM and Gravimetric Reduction (GR)/TEM Analysis

Homogeneous Material		Number of Samples	Mineral	Asbestos Content, %	
				PLM	GR/TEM
NESHAP Method Building (#3602)					
Wallboard	Joint Compound	4	Chrysotile	1-5	10-19
	Joint Interval Composite			NA	4-7
	Non-Joint Skim Coat	4	Chrysotile	ND[a]-<1	NA
Flooring	9- by 9-inch Tile	4	Chrysotile	10-20	14-24
	Sheet	4	Chrysotile	15-25	NA[c]
	Mastic	4	-	ND-<1	NA
Roofing	Shingle	4	-	ND	NA
	Felt	4	-	ND	NA
Glazing Compound		4	Chrysotile	TR[b]	8-9
Attic Insulation		4	-	ND	NA
Alternative Method Building (#3607)					
Wallboard	Joint Compound	4	Chrysotile	1-5	4-10
	Joint Interval Composite			NA	1-4
	Non-Joint Skim Coat	4	Chrysotile	ND-<1	<0.3-2
Flooring	9- by 9-inch Tile	4	Chrysotile	10-20	17-20
	Sheet	4	Chrysotile	15-25	NA
	Mastic	4	-	ND	NA
Roofing	Shingle	4	-	ND	NA
	Felt	4	-	ND	NA
Glazing Compound		38	Chrysotile/ Tremolite	ND-<1	<0.1
Attic Insulation		4	-	ND	NA

[a]ND = None Detected.
[b]TR = Trace, <1% visual estimate.
[c]NA = Not applicable; i.e., the sample was not analyzed using TEM.

Table A-3 lists the materials present in the NESHAP Method (#3602) and Alternative Method (#3607) Buildings that were found to be asbestos-containing and their corresponding quantities and locations of RACM. These buildings contain asbestos-containing building materials that are commonly present in buildings that could conceivably fall under the AACM.

Prior to demolition of the NESHAP Method Building (#3602), all of the gypsum wallboard and glazing compound (windows and doors) will be removed. The RACM will removed by an ADEQ licensed asbestos abatement contractor in accordance with the Arkansas

Pollution Control and Ecology Commission Regulation 21 (A.C.A. §20-27-1001 and §8-4-11 et seq). Technical Specifications for Asbestos Abatement will be prepared by an ADEQ licensed Asbestos Project Designer. Prior to demolition of the Alternative Method Building (#3607), no asbestos-containing materials will be removed.

Table A-3. RACM Present in the NESHAP Method and Alternative Method Buildings

Sample Group	HA[a]	Material Description	Sample Location	Friable/ Non-Friable	Quantity	Condition
NESHAP Method Building (#3602)						
3602-RFC-02	2	Red Multi-Colored Linoleum	Bathrooms	Non-Friable	252 ft^2	Good
3602-FT-03	3	Brown Floor Tile	Throughout	Non-Friable	3,992 ft^2	Good
3602-WG-05	5	Window Glazing	Windows	Friable	814 lf	Damaged
3602-JC-06	6	Wallboard Joint Compound	Throughout	Non-Friable	20,700 ft^2	Good
Alternative Method Building (#3607)						
3607-RFC-02	2	Red Multi-Colored Linoleum	Bathrooms	Non-Friable	252 ft^2	Good
3607-FT-03	3	Brown Floor Tile	Throughout	Non-Friable	3,992 ft^2	Good
3607-JC-06	6	Wallboard Joint Compound	Throughout	Non-Friable	20,700 ft^2	Good

[a]HA = Homogeneous Area

A6.1.1.2 Lead Paint Inspection of Buildings

The NESHAP Method (#3602) and Alternative Method (#3607) Buildings were surveyed for inorganic lead to characterize the potential for occupational exposure during demolition and landfilling of the resultant construction debris.[3] The samples were prepared for analysis in accordance with EPA SW-846 Method 3050 and analyzed by inductively coupled plasma atomic emission spectroscopy (ICP-AES) in accordance with EPA SW-846 Method 6010.

[3] The OSHA Lead Standard (29 CFR §1926.62) does not define lead-paint based on the amount of lead present. That is, the standard does not specify a minimum amount or concentration of lead that triggers a determination that lead is present and the potential for occupational exposure exists. It is theoretically not possible to exceed the OSHA permissible exposure limit of 50 $\mu g/m^3$, 8-hour time-weighted average (TWA) if the lead-content is $\leq$600 ppm (equivalent to 0.06%). Accordingly, exposure monitoring must be conducted when the lead content of the material is $\geq$ 600 ppm to determine if a worker is being exposed to lead at or above the action level of 30 $\mu g/m^3$ 8-hour TWA.

Table A-4 presents the levels of lead measured in paint chip samples obtained from Buildings #3602 and #3607. Because the paint contains >600 ppm lead, personal exposure monitoring will be conducted during asbestos abatement of Building #3602 and during demolition of both buildings in accordance with OSHA Lead Standard 29 CFR §1926.62. Prior to demolition of the buildings, three representative composite bulk samples of the lead-containing building materials will be analyzed to determine the leachable lead content (EPA SW-846 Method 1311, *Toxicity Characteristic Leaching Procedure*), as required by the local landfill operator. In addition, subsequent to demolition of the buildings three representative bulk samples of soil will be collected for leachable lead.

Table A-4. Concentrations of Lead in Paint Chip Samples From Interior and Exterior Building Components

Building Component	Number of Samples	Concentration of Lead, ppm		
		Mean	Minimum	Maximum
NESHAP Method (#3602) Building				
Millwork	4	11,400	4,400	24,000
Gypsum wallboard	4	1,313	500	2,000
Exterior clapboard siding	4	81,500	34,000	120,000
Alternative Method (#3607) Building				
Millwork	4	12,000	8,000	15,000
Gypsum wallboard	4	1,225	1,000	4,000
Exterior clapboard siding	3	55,333	46,000	73,000

A6.1.1.3 Concentrations of Asbestos in Soil

A total of nine individual soil samples were collected for asbestos. Three samples were collected from beneath each of the two buildings, and three samples were collected from the perimeter of the two buildings at approximately 15 feet from the face of the buildings.

The soil samples were collected by using a clean scooping tool to acquire approximately the top ½-inch of soil from a 10-inch by 10-inch area. The samples were analyzed for asbestos content by using PLM and dispersion staining in accordance with EPA's "*Method for the Determination of Asbestos in Bulk Building Materials*" (EPA/600/R-93/116, July 1993). The soil samples were also analyzed for asbestos by using gravimetric reduction and subsequent TEM analysis described in the above method. The asbestos contamination levels present in the soil are summarized in Table A-5.

Table A-5. Asbestos in Soil (PLM and Gravimetric Reduction (GR/TEM)

<table>
<tr><th rowspan="2">Location</th><th rowspan="2">Number of Samples</th><th rowspan="2" colspan="2">Asbestos Found[d]</th><th colspan="2">Asbestos Content, %</th></tr>
<tr><th>PLM</th><th>GR/TEM</th></tr>
<tr><td colspan="6">NESHAP Method (#3602) Building</td></tr>
<tr><td>Beneath Building</td><td>3</td><td colspan="2">Chrysotile</td><td>TR[a]</td><td>BAS[c]</td></tr>
<tr><td colspan="6">Alternative Method (#3607) Building</td></tr>
<tr><td>Beneath Building</td><td>3</td><td colspan="2">Chrysotile, Amosite, Anthophyllite</td><td>TR</td><td>BAS-005</td></tr>
<tr><td colspan="6">Perimeter of Buildings</td></tr>
<tr><td>Perimeter</td><td>3</td><td>ND</td><td>ND</td><td>ND[b]</td><td>BAS</td></tr>
</table>

[a]TR = Trace, <1% by visual estimate.
[b]ND = None Detected.
[c]BAS = Below analytical sensitivity; 0.001 (mass %).
[d]If detected, no more than one fiber was observed in any sample.

A6.1.2 Demolition of Buildings and Site Management

The NESHAP Method Building (#3602) will be demolished in accordance with the procedures specified in 40 CFR Part 61, Subpart M, and in the "*Guide to Normal Demolition Practices Under Asbestos NESHAP*" (EPA-340/1-92-013, September 1992). The Alternative Method Building (#3607) will be demolished by using the demolition practices specified in the "*Alternative Asbestos Control Method*" contained in Appendix A. The NESHAP Method Building (#3602) will be demolished first (including removal of the foundation and all associated debris) and then the Alternative Method Building (#3607) will be demolished. To prevent the potential cross contamination of the Alternative Method Building during demolition of the NESHAP Method Building, the Alternative Method Building as well as the soil within the containment berm will be covered with 6-mil polyethylene sheeting.

To reduce the number of variables involved in the comparison and to evaluate the NESHAP under optimum conditions in this research study, certain practices of the NESHAP process are prescribed. These practices are listed below:

- A new high-efficiency particulate air (HEPA) filter will be used in each HEPA-filtration unit during the abatement of the NESHAP Method Building.
- In-place performance of the HEPA filtration units will be evaluated using an air-generated dioctyl phthalate (DOP) aerosol as well as by direct measurement (isokinetic sampling) of the asbestos concentration in the discharge air of each unit.
- Demolition equipment will be identical to that used for the Alternative Method Building.
- Demolition debris disposal vehicles will be washed before leaving the NESHAP site.

A6.1.3 Environmental Monitoring During Demolition of Buildings

An analysis was conducted of 3,660 hours of meteorological data (wind direction and wind speed) collected between 07:00 to 18:00 hours from March 1 through April 30 during the years of 1999, 2000, and 2002 through 2004 at the Fort Smith Municipal Airport (Station #13964); see Figure B-8, Section B1.1. The demolition study is projected to be conducted during March 2006; see Figure A-7. The wind direction varied between up to six 20-degree sectors during a given day. Hence, it was concluded that the primary air sampling design should be based on a concentric ring approach rather than on an upwind to downwind approach (see Section B1). This study design is consistent with the primary objective of this project: i.e., to compare the effectiveness of the Alternative Asbestos Control Method to the Asbestos NESHAP Method.

A6.1.3.1 Perimeter Air Monitoring During Demolition

A series of stationary air monitors will be positioned to measure the concentration of airborne asbestos fibers from demolition of the NESHAP Method (#3602) and Alternative Method (#3607) Buildings. The movement of the released asbestos fibers with the prevailing winds (transport), the vertical movement of the fibers due to turbulence (dispersion), and the amount of fibers removed due to deposition will be influenced by the physical properties of asbestos fibers, the release characteristics during demolition and debris handling, and by meteorological conditions.

The perimeter air monitoring network will consist of three concentric rings around the rectangular-shaped buildings (see Section B1). The monitors will be distributed at approximately equal distances along each of the three rings. The monitors will be placed at two heights (5- and 15-ft) on Ring #1 (the primary ring) and will be placed at a height of 5-ft on Rings #2 and #3.

The distance of the rings from the face of the building was determined by using two EPA dispersion models: SCREEN3 and ISCST3 (see Section B1). SCREEN3 (a Gaussian plume dispersion model) is a screening tool that uses a worst-case meteorology to produce a conservative one-hour average air concentration estimate. A refined modeling analysis was then conducted by using the ISCST3 (a steady-state Gaussian model) to predict location (i.e., lateral distance and height above ground level) where the maximum concentration of airborne asbestos is likely to occur.

The placement of the monitors will be sited and documented by using a global positioning system (Thales® Navigation MobileMapper GIS Data Collection System).

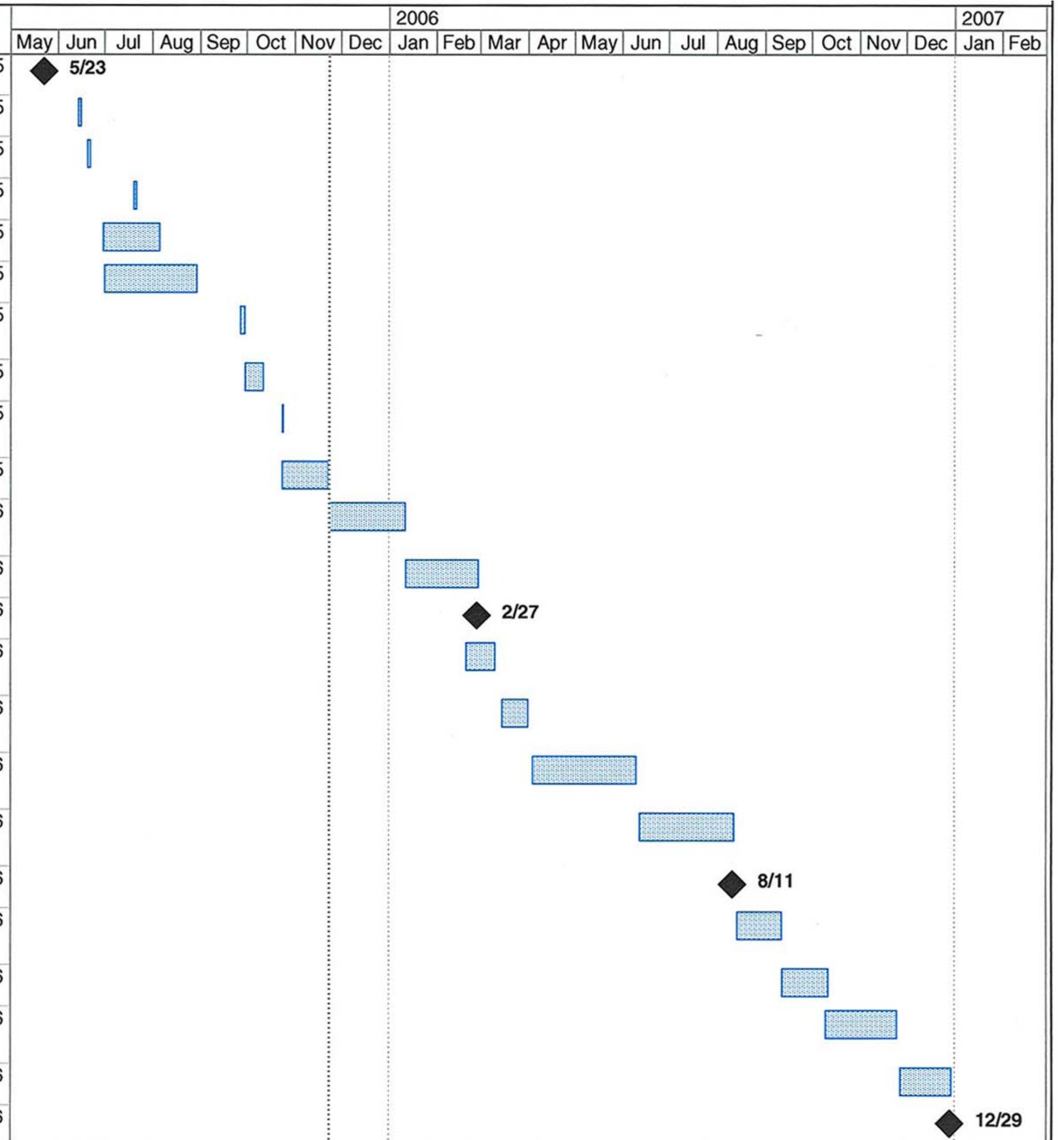
Meteorological conditions (such as wind direction and wind speed) will be determined during sampling. For this study, if sustained wind speeds of 15 mph (60-minute average) or gusts above 20 mph are encountered, demolition and monitoring will pause until the wind speed is less than these conditions.

The demolition activities will be divided into two periods: morning and afternoon. All stationary monitors will be activated shortly before demolition activities begin, and will continue until demolition activities cease for that period. Each building demolition is expected to take one day.

A6.1.3.2 Personal Air Monitoring of Workers During Demolition

All workers directly involved with demolition of the building and handling of resultant debris will wear personal protective equipment as specified in the site-specific Health and Safety Plan (HASP). In accordance with OSHA Standards 29 CFR §1926.1101 (Asbestos) and 29 CFR §1926.62 (Lead), each worker's personal breathing zone exposure concentration to asbestos fibers and lead will be measured. In addition, this monitoring will provide a reasonable characterization of the asbestos and lead concentrations in air closest to the source of any potential release; i.e., building demolition and debris loading.

ID	Task Name	Start	Finish
1	Contract Award	Mon 5/23/05	Mon 5/23/05
2	Kick-Off Meeting	Tue 6/14/05	Wed 6/15/05
3	Initial Site Inspection Ft. Chaffee	Mon 6/20/05	Tue 6/21/05
4	Inspection of Candidate Buildings	Wed 7/20/05	Thu 7/21/05
5	Literature Search	Thu 6/30/05	Fri 8/5/05
6	1st Draft QAPP	Fri 7/1/05	Mon 8/29/05
7	QAPP Technical Development Team Review Meeting - Cincinnati	Tue 9/27/05	Thu 9/29/05
8	Revise QAPP	Fri 9/30/05	Tue 10/11/05
9	QAPP Technical Development Team Comments on Revised QAPP	Mon 10/24/05	Mon 10/24/05
10	Revise QAPP	Mon 10/24/05	Tue 11/22/05
11	External Peer Review/Public Review of QAPP	Wed 11/23/05	Wed 1/11/06
12	Finalize QAPP	Thu 1/12/06	Mon 2/27/06
13	Submit Final QAPP	Mon 2/27/06	Mon 2/27/06
14	Asbestos Abatement NESHAP Building and Background Air Sampling	Mon 2/20/06	Fri 3/10/06
15	Conduct Building Demolitions at Fort Chaffee (Weather Dependent)	Wed 3/15/06	Fri 3/31/06
16	Laboratory Analysis/Data Validation	Tue 4/4/06	Fri 6/9/06
17	Data Analysis and Preparation of Draft Final Report	Mon 6/12/06	Fri 8/11/06
18	Draft Final Report	Fri 8/11/06	Fri 8/11/06
19	Review 1st Draft Final Report by QAPP Technical Development Team	Mon 8/14/06	Mon 9/11/06
20	Revise 1st Draft Final Report	Tue 9/12/06	Wed 10/11/06
21	External Peer Review/Public Comment 2nd Draft Final Report	Tue 10/10/06	Fri 11/24/06
22	Finalize Final Report	Mon 11/27/06	Fri 12/29/06
23	Submit Final Report	Fri 12/29/06	Fri 12/29/06



Project: Building Demolition Evaluation at Fort Chaffee
Date: Wed 11/23/05

Task | Milestone

Figure A-7. Project Schedule for Building Demolition Evaluation at Fort Chaffee

A6.1.3.3 Impact on Soil from Demolition

The potential impact on the soil will be evaluated by comparing the asbestos concentrations in the soil before ("baseline") and after demolition. For the NESHAP Method Building, the asbestos concentration in the soil following demolition will be used for this comparison. For the Alternative Method Building, since the Alternative Asbestos Control Method requires that two to three inches of soil be excavated following demolition, the asbestos concentration in the soil after excavation will be used for this comparison.

A6.1.3.4 Settled Dust from Demolition

The amount (concentration) of asbestos deposited on surfaces around the site during building demolition and debris handling of the Asbestos NESHAP Method Building will be compared to that deposited during building demolition and debris handling using the Alternative Asbestos Control Method. The samplers will be placed at the same locations as some of the perimeter air samples (see Section A6.1.3.1).

A6.1.3.5 Water used During Demolition

Source Water—Samples of the source water (i.e., fire hydrant water) applied during both the NESHAP Method and Alternative Asbestos Control Methods will be collected for asbestos analysis at both the commencement and completion of the respective building demolitions. Also, background water samples from the hydrant will be taken and analyzed for asbestos prior to the test. If the source water contains asbestos, an alternative non-asbestos-containing water supply will be used for this study.

The hydrant water will be applied to both the NESHAP Method and Alternative Method Buildings with a variable rate 11-G (11 gpm) or 30-G (30 gpm) nozzle. A water meter (or equivalent device) will be installed at the hydrant to measure the volume of water applied to each of the buildings.

For the Alternative Method Building, the surfactant used to create the amended water will be applied using an in-line eductor. A sample of the amended water used will also be collected.

Surface Water—Representative samples of surface water will be collected during the duration of the demolition activity for both the NESHAP Method and Alternative Method Buildings. Small impervious drainage channels will be constructed to assure surface water runoff collection in metal-fabricated basins located within the containment berm. The containment berm will be sufficiently spaced from the building to permit the movement of the demolition equipment and to allow the truck loading to occur within the enclosed space. The sampling of the collected runoff water will be spaced over the duration of the demolition activity. Sample collection volumes will be noted as a function of time and as a function of the progression of the demolition.

A6.1.3.6 Soil Elutriation Tests

Soil samples will be collected to measure the asbestos concentration in respirable dust from residual asbestos fibers in the soil before and after demolition of the buildings. The soil samples will be prepared for analysis using the *Modified Elutriator Method for the Determination of Asbestos in Soils and Bulk Materials* (Revision 1), May 23, 2000; see Section B.2.7.

A6.1.4 Air Monitoring at Landfill

A6.1.4.1 Perimeter Air Monitoring During Landfilling of Debris

A series of stationary air monitors will be positioned to measure the release of airborne asbestos fibers during landfilling of the demolition debris from the NESHAP Method (#3602) and Alternative Method (#3607) Buildings.

The perimeter air monitoring network will consist of one ring of monitors. The goal will be to place the monitors at 40-degree intervals measured along a radius from the center of the asbestos landfilling activity as site conditions permit; i.e., topography and other landfilling activities. The monitors will be placed at a height of five feet above ground. The monitors will be sited and documented by using a global positioning system (Thales® Navigation MobileMapper GIS Data Collection System).

Meteorological conditions (such as wind direction and wind speed) will be determined during sampling. If sustained wind speeds of 15 mph (60-minute average) or gusts above 20 mph are encountered, landfilling will pause until the wind speed subsides below these levels.

A6.1.4.2 Perimeter Air Monitoring During Landfilling of Bagged ACM Debris from NESHAP Method Building

A series of stationary air monitors will be positioned to measure the release of airborne asbestos fibers during landfilling of bagged ACM from the NESHAP Method Building (#3602). The perimeter air monitoring network will consist of one ring of monitors. The goal will be to place the monitors at 40-degree intervals measured along a radius from the center of the asbestos landfilling activity as site conditions permit; i.e., topography and other landfilling activities. The monitors will be placed at a height of 5 feet above ground. The monitors will be sited and documented by using a global positioning system (Thales® Navigation MobileMapper GIS Data Collection System).

Meteorological conditions (such as wind direction and wind speed) will be determined during sampling. If sustained wind speeds of 15 mph (60-minute average) or gusts above 20 mph are encountered, landfilling will pause until the wind speed subsides below these levels.

A6.1.4.3 Air Monitoring of Workers During Landfilling

All workers directly involved with the landfilling of the demolition debris will wear personal protective equipment as specified in the site-specific Health and Safety Plan (HASP). In accordance with OSHA Standard 29 CFR §1926.1101 (Asbestos) and 29 CFR §1926.62 (Lead), each worker's personal breathing zone exposure concentration to asbestos fibers and lead will be measured. In addition, this monitoring will provide a reasonable characterization of the asbestos and lead concentrations in air closest to the source of any potential release; i.e., landfilling of the debris.

A6.1.5 Background Perimeter Air Monitoring

A6.1.5.1 Air Monitoring Prior to Asbestos Abatement of NESHAP Method Building

Air monitoring prior to asbestos abatement of the NESHAP Method Building will be conducted to collect data to compare air concentrations of asbestos during demolition to comparative background[4] concentrations. The monitoring will be conducted on one day immediately prior to abatement of the building. Monitoring will be conducted between

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4 Environmental "comparative" background is the airborne concentration of asbestos that is normally present in the area of the subject activity; i.e., building demolition site at Fort Chaffee or landfilling activity at the City of Fort Smith Class D Landfill.

approximately 08:00 and 12:00 hours and between 12:00 to 16:00 hours. The same number of samples will be collected during each sampling event. The air monitoring network will consist of one ring of monitors around the building. The monitors will be placed at 60-degree intervals measured along a radius from the center of the building. The monitors will be placed within 15 feet of the building and at a height of 5 feet above ground. If wind conditions exceed 15 mph average or 20 mph gusts, sampling will be delayed until acceptable conditions resume.

The monitors will be sited and documented, and the meteorological conditions (such as wind direction and wind speed) will be determined as described in Section A6.1.3.1.

A6.1.5.2 Air Monitoring Prior to Demolition of Alternative Control Building

Air monitoring prior to demolition of the Alternative Control Building will be conducted to collect data to compare air concentrations of asbestos during demolition to comparative background concentrations. The monitoring will be conducted prior to demolition as described in Section A6.1.5.1.

The monitors will be sited and documented, and the meteorological conditions (such as wind direction and wind speed) will be determined as described in Section A6.1.3.1.

A6.1.5.3 Air Monitoring Prior to Landfilling of Bagged ACM and Building Debris

Air monitoring prior to landfilling will be conducted to collect data to compare air concentrations of asbestos during landfilling to comparative background concentrations. The monitoring will be conducted prior to landfilling as described in Section A6.1.5.1.

The monitors will be sited and documented, and the meteorological conditions (such as wind direction and wind speed) will be determined as described in Section A6.1.3.1.

A6.1.6 Air Monitoring During Asbestos Abatement of NESHAP Method Building

A6.1.6.1 Air Monitoring of Discharge Air from HEPA-Filtration Units

Previous studies conducted by EPA of air filtration units equipped with HEPA filtration to maintain a negative static air pressure at asbestos abatement sites showed that a large percentage of the units discharged asbestos fibers (Kominsky et al 1989; and Wilmoth et al 1993). In-duct monitoring of the discharge air from each HEPA-filtration unit used during the abatement of the NESHAP Building will be conducted. In-place performance will be conducted to determine each HEPA filtration unit's particle-removal efficiency using an air-generated dioctyl phthalate (DOP) aerosol (Kominsky et al 1989). Isokinetic sampling[5] will also be conducted of the discharge air of each air filtration unit during abatement to determine the asbestos fiber concentration (Wilmoth et al 1993).

A6.1.6.2 Air Monitoring of Ambient Air during Loading of Bagged ACM

The air around the disposal container (e.g., truck or roll-off container) will be monitored to determine whether this loading activity releases airborne asbestos fibers above comparative background (see Section A6.1.5.1). The removed materials (e.g., gypsum wallboard) will be double bagged in 6-mil polyethylene bags. The bagged material will be stored in the building and loaded out during one event. If space restrictions require the material to be loaded out more frequently, each event will be monitored.

The monitors will be placed at 60-degree intervals measured along a radius from the center of the disposal container. The monitors will be placed within 10 feet of the loading area and at heights of 5 feet and 15 feet above ground. The monitors will be sited and documented, and the meteorological conditions (such as wind direction and wind speed) will be determined as described in Section A6.1.3.1.

A6.2 Personnel

The key project personnel are identified in the project organization chart presented in Figure A-1.

A6.3 Project Schedule

The proposed project schedule is presented in Figure A-7. The project schedule commences with Contract Award on May 23, 2005 and is completed with submission of the final report on December 29, 2006. The project schedule shows the major tasks, duration, and deliverables.

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[5] In isokinetic sampling, the velocity of air entering the sample nozzle (V_n) is the same as the velocity of the air stream (V_s). That is, the area of the sample nozzle tip opening (A_n) and the sample volume flow rate (Q_s) must be adjusted to obtain a velocity ($V_n = Q_s/A_n$) equal to the air stream velocity (V_s) at the sampling point. The sampling constraint ($V_n = V_s$) is termed *isokinetic* sampling or *equal velocity* sampling.

A7 QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

The overall quality assurance objective of this project is to implement procedures for field sampling, laboratory analysis, and reporting that will provide data for the development of scientifically valid conclusions and support decision making regarding the project objectives identified in Section A5.2. EPA has developed a seven-step Data Quality Objective (DQO) procedure designed to ensure that data collection plans are carefully thought out and to maximize the probability that the results of the project will be adequate to support decision-making (EPA QA/G-4, August 2000, EPA/600/R-96/055). This seven-step decision process has been applied to the Primary Project Objectives.

A7.1 First Primary Objective

To determine if the airborne asbestos (TEM) concentrations from the Alternative Method are statistically equal to or less than the NESHAP Method.

A7.1.1 Step 1: State the Problem

The asbestos NESHAP (40 CFR Part 61, Subpart M) requires the removal of all RACM prior to demolition of the facility. Asbestos removal in accordance with NESHAP can account for a significant portion of the total demolition cost. Reportedly, a common practice among municipalities is to allow orphaned structures to decay to the point of collapse prior to demolition due to the expense of NESHAP abatement. Demolition of these asbestos-containing buildings that have been declared to be unsafe for entry could result in the release of asbestos to the environment.

The EPA will perform a controlled demonstration as part of the Agency’s effort to compare the effectiveness of the Alternative Asbestos Control Method to the NESHAP Method. The Alternative Asbestos Control Method, if successful, would likely accelerate the demolition of many orphaned buildings around the nation that remain standing and present a variety of potentially serious risks to nearby residents.

A7.1.2 Step 2: Identify the Decision

Is the airborne concentration of asbestos during demolition of a building and debris loading using the Alternative Asbestos Control Method equal to or less than the concentration of asbestos during demolition of a building and debris loading in accordance with the Asbestos NESHAP Method?

A7.1.3 Step 3: Identify Inputs to the Decision

Information that is required to resolve the decision statement:

1. Accurate and representative measurements of airborne asbestos concentrations released during demolition of the buildings using the NESHAP Method and Alternative Asbestos Control Methods.

2. An analytical sensitivity that is sufficiently low to detect a difference between the two demolition methods.

3. Accurate and representative measurements of the wind speed and wind direction during demolition of the buildings.

A7.1.4 Step 4: Define the Study Boundaries

1. *Spatial boundary of the decision statement*: This decision related to the air concentration of asbestos is defined as the area within the outermost ring around the NESHAP Method Building (#3602) and the Alternative Method Building (#3607). The outermost ring is approximately 100 feet from the face of the building. The spatial boundary around Buildings #3602 and #3607 is shown in Figures B-10 and B-11, respectively (see Section B). Further, decisions regarding the air matrix apply to air within the breathing zone of potentially exposed individuals engaged in demolition and debris handling at the Fort Chaffee site.

2. *Temporal boundary of the decision statement*: Weather conditions such as freezing temperatures will impede the demolition contractor's ability to adequately wet the structure. Rain conditions may influence the transport and deposition of asbestos fibers released from demolition and debris handling. The study will not be conducted during rain conditions. Sustained wind speeds of 15 mph (60-minute average) or gusts above 20 mph may affect the transport and dispersion of asbestos fibers; i.e., the asbestos concentration would be inversely proportional to the wind speed. To ensure that this does not occur, demolition and sampling will cease when the wind speed in the area exceeds these values and will resume when conditions stabilize. To ensure adequate conditions to detect any visible emissions that are visually detectable without the aid of instruments, the demolition will be conducted during daylight hours (07:00 to 19:00 hours).

3. *Practical constraints on data collection:*

- Loading of particulate on a single sample filter collected over the entire one-day period of the demolition and debris loading activities could prevent the direct preparation of the filters for TEM analysis.[6] To minimize the probability of such an occurrence, two consecutive samples of 4-5 hours will be collected over a single workday. Although undesirable, should overloading occur on most filters, an indirect TEM method will be used for analysis (ISO 13794:1999).

- The number and placement of stationary air monitors could be affected by demolition and debris handling activities. This is particularly applicable on the north side of the buildings where the demolition excavator is located and debris loading activities will occur. Physical constraints for demolition equipment access may necessitate the movement of some samplers as the physical conditions require.

A7.1.5 Step 5: Develop a Decision Rule

The decision rule is based on the comparison of the air concentration of asbestos from the demolition of the Alternative Method Building to that for the NESHAP Method Building. The null hypothesis is that the geometric mean airborne asbestos concentration from the demolition of the Alternative Method Building is equal to or less than the geometric mean concentration from the demolition of the Asbestos NESHAP Method Building. The alternative hypothesis is that the geometric mean airborne concentration released from the demolition of the Alternative Method Building is greater than the geometric mean concentration from the demolition of the Asbestos NESHAP Method Building. All tests will be conducted at the 0.05 level of significance.

A7.1.6 Step 6: Tolerable Limits on Decision Errors

Airborne asbestos measurements tend to be highly variable and to follow a significantly skewed distribution, most of which are conveniently modeled using the lognormal distribution. A lognormal random variable Y is such that the natural logarithm, $X = \ln(Y)$, has a normal distribution $N(\mu, \sigma^2)$ with mean μ and standard deviation σ. Alternatively, $Y = e^X$ where X has a normal distribution. As this formulation shows, all values of a lognormal random variable are

[6] The direct transfer TEM method (ISO 10312:1995) should not be used if the general particulate loading of the sample collection filter exceeds approximately 10 $\mu g/cm^2$ of filter surface, which corresponds to approximately 20 percent coverage of the collection filter by particulate.

strictly positive. Therefore, any nondetect airborne asbestos measurements (i.e., samples for which no asbestos fibers are detected on any of the grid openings viewed by the analyst) must be assigned a positive value for purposes of lognormal modeling. The assigned value should be less than or equal to the airborne asbestos concentration corresponding to a single measured fiber, which is the smallest detectable value that can be reported. The simplest approach is to assign to any nondetect measurement an airborne asbestos concentration one-half that corresponding to a single measured fiber. Recognizing that this assignment is somewhat arbitrary, we will test the robustness of our conclusions by performing a sensitivity analysis. That is, we will repeat the statistical test described in this section using different fixed assigned values for nondetects, and also using a random assigned value for each nondetect. We expect that the sensitivity analysis will show the same results as the base analysis. However, if it does not, the results of the lognormal model will be considered inconclusive, and alternative approaches (e.g., nonparametric approaches such as the Wilcoxon rank test, see Section 3.1 below) will be explored.

The statistical model on which the comparison of airborne asbestos concentrations between the two methods is based is as follows:

$$\ln(N) = N(\mu_1, \sigma^2)$$

$$\ln(A) = N(\mu_2, \sigma^2)$$

where N refers to the NESHAP Method and A refers to the Alternative Method. The hypothesis test to be conducted is:

$$H_0: \mu_2 \leq \mu_1 \text{ vs. } H_1: \mu_2 > \mu_1$$

That is, the null hypothesis H_0 is that airborne asbestos concentrations from the Alternative Asbestos Control Method are less than or equal to those from the Asbestos NESHAP Method, while the alternative H_1 is that airborne asbestos concentrations from the Alternative Asbestos Control Method are greater than those from the Asbestos NESHAP Method. Because of the lognormal model, the comparison is implicitly between the geometric mean concentrations from the two methods.

The hypothesis test will be carried out using the *two sample t-test* (Bickel and Doksum 1997) applied to the natural logs of the 18 airborne asbestos measurements taken at the five-ft level in the primary ring (see Section B1) for each method. If the mean asbestos concentration is higher for samples collected at the 15-ft feet height than the mean asbestos concentration at the five-ft height for both the NESHAP Method and Alternative Method tests, then the 15-ft sample concentrations will be used for the comparison. A detailed discussion of the statistical analysis is presented in Section B10.3. The null hypothesis will be rejected; i.e., we will conclude that airborne asbestos releases from the Alternative Asbestos Control Method are greater than those from the Asbestos NESHAP Method, if:

$$T > t_{34}(0.95) = 1.6909$$

where T is the two-sample t-statistic and $t_{34}(0.95)$ is the 95th percentile of the t-distribution with 34 degrees of freedom (df). This test has a Type I error rate of 5%; i.e., there is no more than a 5% probability of falsely rejecting the null hypothesis H_0. Thus, there is only a 5% chance of falsely concluding that airborne asbestos concentrations from the Alternative Asbestos Control Method are greater than those from the Asbestos NESHAP Method.

The statistical power of the test, also called the Type II error rate, refers to the probability that the test will reject the null hypothesis, i.e., will correctly conclude that airborne asbestos concentrations from the Alternative Asbestos Control Method are greater than those from the Asbestos NESHAP Method when, in fact, they are. The power of the test depends on the magnitude of the difference between the methods and on the variability to be expected in the airborne asbestos measurements. Specifically, under the alternative hypothesis H_1, the two-sample t-statistic has a *noncentral t distribution* with 34 df and *noncentrality parameter:*

$$\delta = 3(\mu_2 - \mu_1)/\sigma$$

The probability of detecting a given difference ($\mu_2 - \mu_1$) between the methods is given by:

$$\Pr(\tau(34, \delta) > 1.6909)$$

where $\tau(34, \delta)$ is the noncentral t-distribution with 34 df.

In order to evaluate this probability, an estimate of the standard deviation σ of the natural log of a single airborne asbestos measurement is needed. To develop this estimate, a meteorological database of measurements of wind direction at Fort Smith was used. The database contained 5 years of wind direction data from 07:00 to 18:00 hours during the months of March and April (the years available were 1999, 2000 and 2002-2004). For each day, the database contains the number of hours during the 12-hour period between 07:00 to 19:00 hours that the wind blew from each of eighteen 20-degree sectors. For example, on March 18, 2003, the wind was in the 20-degree sector north of due east for 4 of the 12 hours, and in the 20-degree sector to the south of due east for 8 hours.

The most important factor influencing the amount of asbestos collected at each of the 18 primary monitors to be positioned around each building during demolition is the number of hours that each monitor is downwind from the demolition activity. The meteorological data were used to estimate the probability distribution of the number of hours a randomly-positioned monitor would be downwind during March and April at Fort Smith. Table A-6 shows the results of the calculation.

Let D represent the airborne asbestos measurement that would be obtained by a monitor downwind from demolition for 1 hour, and let B represent background airborne asbestos concentration. Let Y be a random variable representing the airborne asbestos measurement reported from a randomly-placed monitor on a random day in March or April at Fort Smith. Then the mean, variance, and coefficient of variation (CV) of Y are computed as follows (using the probabilities in Table A-6):

$$E(Y) = B(0.71512) + (B+D)(0.12149) + (B+2D)*(0.06557) + \ldots + (B+11D)*(0.00091)$$
$$V(Y) = E(Y^2) - E(Y)^2$$
$$CV(Y) = V(Y)^{0.5}/E(Y)$$

Table A-6. Probability Distribution of Number of Hours Downwind Between 7 AM and 7 PM (March and April at Fort Smith, AR)

Hours Downwind	Frequency	Probability
0	3926	0.71512
1	667	0.12149
2	360	0.06557
3	219	0.03989
4	146	0.02659
5	80	0.01457
6	52	0.00947
7	16	0.00291
8	13	0.00237
9	6	0.00109
10	5	0.00091
11	0	0.00000
12	0	0.00000
TOTAL	**5490**	**1.00000**

Calculations show that the CV increases with the ratio D/B, reaching a limiting value of 2.07 when D/B is very large; i.e., the downwind concentration is much larger than background. For a lognormal distribution, a CV of 2.07 corresponds to a value $\sigma = 1.29$ for the underlying normal distribution. Therefore, these calculations indicate that $\sigma = 1.29$ is likely a conservative value to use in the power calculations for the two-sample t-test above.

Table A-7 shows the power of the two-sample t-test to detect various differences between the Alternative Asbestos Control Method and the Asbestos NESHAP Method with $\sigma = 1.29$. The differences are expressed as the ratio of the geometric mean concentration for the Alternative Method to the geometric mean concentration for the NESHAP Method.

Table A-7 shows that a 5-fold difference between the Alternative Asbestos Control Method and the Asbestos NESHAP Method has a 98% probability of being detected by the two-sample t-test based on 18 samples per building in the primary ring, even with a conservative estimate of the variability of airborne asbestos levels during the demolition. To the extent that $\sigma < 1.29$, the power of the test will be increased. For example, if the downwind asbestos level D for the NESHAP method is comparable to, or at least not many times greater than, the background level B, the ability to detect differences between the Alternative and NESHAP methods will be enhanced. Once the data are available from the study, a variety of statistical approaches, both parametric and non-parametric, will be utilized to determine which most appropriately fits the data set.

Table A-7. Power of Two-Sample t-Test for Airborne Asbestos Comparison Based on Sample Sizes of 18 and 15

GM*(Alternate)/GM(NESHAP)	Detection Probability (N=18)	Detection Probability (N=15)
2	0.47	0.42
3	0.81	0.74
4	0.94	0.88
5	0.98	0.95
6	0.993	0.98
7	0.997	0.99

* Geometric Mean

The statistical design is robust with respect to the accidental loss of a small number of monitoring stations (samples) during the demolition process. For example, Table A-7 compares the power of the proposed two-sample t-test for comparison of airborne asbestos concentrations between the NESHAP and Alternative methods for the full sample size of 18 monitoring stations versus a smaller sample size of 15 stations. Table A-7 shows only a modest decrease in detection capability even if 3 monitors of the 18 originally specified (17%) were to be randomly damaged or destroyed during the demolition process.

A7.1.7 Step 7: Optimize the Design for Obtaining Results

1. EPA dispersion models SCREEN3 and ISCST3 were used to estimate the location where the maximum airborne asbestos concentrations during demolition and debris loading would most likely occur. The lateral (distance from building and debris loading activities) and vertical (height above ground) placements predicted by the models were evaluated using best engineering judgment to determine the reasonableness of the predicted locations.

2. The most important factor influencing the airborne asbestos concentration measured at one of the 18 primary monitors (i.e., innermost ring) to be positioned around each building during demolition is the number of hours that monitor is downwind from the demolition activity. The project team's statistician performed an analysis of 5 years (1999, 2000, 2002-2004) of meteorological data to estimate the probability distribution of the number of hours that a monitor is downwind from the demolition activity. The wind direction varied between up to six 20-degree sectors during a given day. Hence, it was concluded that the primary air sampling design should be based on a concentric ring approach rather than on an upwind to downwind approach.

A7.1.8 Analytical Sensitivity

The data generated for this project must be obtained with an analytical sensitivity sufficiently low to detect a difference between the two demolition methods. The target analytical sensitivity will be 0.0005 structure/cubic centimeter of air (s/cm^3) for all asbestos structures (minimum length of $\geq$0.5 µm).

An analytical sensitivity of 0.0005 s/cm^3 was selected for the following reasons: 1) It is believed to be sufficiently low to detect a difference between the air concentrations of asbestos generated by the two demolitions methods. 2) It is near concentrations that have been reported as a background level of asbestos in ambient air (EPA 1986). 3) It has been used in other EPA ambient air studies (Stewart 2003; California Environmental Protection Agency 2003; Wilmoth et al 2004; Wilmoth et al 1990; Kominsky and Freyberg 1995 and Contaminants of Potential Concern Committee of the World Trade Center Indoor Air Task Force Working Group" (May 2003).

Achieving the analytical sensitivity for asbestos in air samples is generally dependent on two factors: the volume of air collected through the filter and the area of the filter analyzed; i.e., the number of grid sections analyzed multiplied by the area of the grid sections analyzed. The required analytical sensitivity will be achieved for each collected air sample by collecting as large a volume of air as practical and by increasing the filter search areas, as needed.

A7.1.9 Data Quality Indicators (DQI)

A7.1.9.1 Sample CollectionDQI

- Precision is the agreement between the measurements collected by two identical devices or measures. Precision is reported as relative percent difference (RPD) between duplicate samples or sample analyses. Precision will be measured by collecting duplicate samples during the sampling events. Duplicate "co-located" samples will be collected during the morning and afternoon sampling events. These samples will also serve as a combined check on the sample collection and analysis procedures.

$$\frac{|Result\ 1 - Result\ 2|}{Mean} \times 100$$

  Precision criteria for co-located samples is presented in Table B-20. If these criteria are not met the effect on project conclusions will be evaluated.

- Completeness is defined as follows:

$$\%Completeness = \frac{V}{N} x100$$

  where V is the number of measurements judged valid, and N is the number of measurements planned. An overall measure of completeness will be given by the percentage of samples specified in the sampling design that yield usable "valid" data. Although every effort will be made to collect and analyze all of the samples specified in the sample design, the sample design is robust to sample loss. The loss of a few samples, provided they are not concentrated at a set of contiguous sectors, will likely have little effect on the false-negative error rate. The project goal is to collect at least 95 percent of the samples specified in the sample design. If completeness objectives are not met the effect on conclusions will be evaluated.

- Representativeness is a subjective measure of the degree that the data accurately and precisely represent the sample collection conditions of the environment. Representative sample collection depends on the expertise and knowledge of the personnel to make sure the samples are collected in a manner that reflects the true concentration in the environment. The sampling locations (as predicted by dispersion modeling), number of samples (18 samples per ring per height), sampling periods, and sampling durations have been selected to ensure reasonable representativeness. Sample collection at two elevations (5 feet and 15 feet) at the inner ring, and at 5-ft at the 2nd and 3rd rings will adequately capture the asbestos air release from demolition and debris loading activities.

- Comparability is a qualitative term that expresses the measure of confidence that one data set can be compared to another and combined for the decision to be made. Data collection using a standard sampling and analytical method (e.g., ISO 10312:1995, counting structures longer than and shorter than 5 µm in length, and PCM equivalent fibers[7]) maximizes the comparability of the results with both past sampling results (if such exist) and future sampling results.

A7.1.9.2 Sample Analysis DQI

Analysis of identical image fields as measured by the principal analytical laboratory (MVA) and the QC laboratory (RTI) will determine the precision data quality indicator. Precision in number of asbestos fibers and asbestos fiber dimensions from the same filters and image fields from selected tests will be measured. Filters loaded with asbestos collected by air filtration have an inherent variability that is exacerbated by the exceedingly small area analyzed by TEM. Although the variability cannot be mitigated by sampling strategies or sampling preparation strategies, it can be quantified, and if factors exist that are artificially magnifying the variability, those factors can in theory be isolated and identified. The best approach to this is through interlaboratory re-preparation and re-analysis of filters and intra-laboratory re-preparation and re-analysis of filters. Interlaboratory re-analysis establishes that the variability is not caused by the laboratory's sample preparation and analytical techniques. If the laboratory was improperly preparing the samples and was causing the results to consistently bias high or low, then the second laboratory's analysis of numerous samples should reveal this trend. If the samples had exceedingly high variability across the filter (or if the lab was causing artificial variability through sample preparation and analysis techniques), then this would be revealed by re-preparation and analysis of the filter by the same laboratory.

Because no reference materials are available to assess the accuracy of the TEM measurements, the best approach is to establish consensus standards through duplicate analysis of precise sub-samples. This is accomplished through a procedure called "verified counting," which is documented in a National Institute of Standards and Technology (NIST) technical guide and used by asbestos analytical laboratories. Two laboratories (in this case the principal analytical laboratory and the QC laboratory) analyze precise identical areas of the sampling filter, and compare their results, which consist of numbers of asbestos structures and drawings and dimensions of each asbestos structure. In this fashion, they can mutually agree on the concentration of asbestos in the sub-sample, and can verify that each is following the very

[7] A PCM (phase contrast microscopy) equivalent fiber is a fiber with an aspect ratio greater than or equal to 3:1, longer than 5 µm, and which has a diameter equal to or greater than 0.25 µm.

specific guidelines for asbestos structure counting by TEM. Any lack of precision or presence of bias can be readily established and quantified.

See Section B5 regarding the QA/QC criteria for the analytical method data quality indicators (DQI).

A7.2 Second Primary Objective

To determine if the post-excavation asbestos concentrations in the soil from the Alternative Method are statistically equal to or less than the post-demolition NESHAP Method.

A7.2.1 Step 1: State the Problem

Demolition of buildings could result in contamination of the soil beneath and around the building. The extent and magnitude of any such release is not known. This information is important in comparing the Alternative Asbestos Control Method to the NESHAP Method.

A7.2.2 Step 2: Identify the Decision

Is the post-excavation asbestos concentration in the soil from the Alternative Method statistically equal to or less than the concentration from the post-demolition NESHAP Method?

A7.2.3 Step 3: Identify Inputs to the Decision

Information that is required to resolve the decision statement:

1. Accurate and representative measurements of asbestos concentrations in the post-excavation soil from the Alternative Method and in the post-demolition soil from the NESHAP Method building demolitions.

2. An analytical sensitivity that is sufficiently low to detect a difference between the two demolition methods as well as comparative background soil concentrations that will be measured prior to demolition.

A7.2.4 Step 4: Define the Study Boundaries

Spatial boundary of the decision statement: This decision related to the release of asbestos to soil is defined as the area within the containment berm for the NESHAP Method Building (#3602) and that for the Alternative Method Building (#3607).

A7.2.5 Step 5: Develop a Decision Rule

The decision rule is based on the comparison of the asbestos concentration in the post-excavation soil from the Alternative Method Building to the post-demolition soil from the NESHAP Method Building. The null hypothesis is that the geometric mean asbestos concentration in the post-excavation soil from demolition of the Alternative Method Building is equal to or less than the geometric mean concentration in the soil from demolition of the Asbestos NESHAP Method Building. The alternative hypothesis is that the geometric mean concentration in post-excavation soil from the Alternative Method Building is greater than the geometric mean concentration in the post-demolition soil from the Asbestos NESHAP Method Building. All tests will be conducted at the 0.05 level of significance.

A7.2.6 Step 6: Tolerable Limits on Decision Errors

The comparison of post-method asbestos soil concentrations for the NESHAP Method and Alternative Method buildings will be based on 10 interleaved composite samples per containment berm of the building. A detailed discussion of the statistical analysis is presented in Section B10.3. Once the data are available from the study, a variety of statistical approaches, both parametric and non-parametric, will be utilized to determine which most appropriately fits the data set. Since the chrysotile airborne asbestos concentrations often best fit a log-normal distribution, we will assume that the lognormal model used for the airborne asbestos comparison is also applicable to the soil concentrations. In this case, with 10 samples per containment berm, the two-sample t-test rejects the null hypothesis that the post-excavation asbestos concentration in the soil from the Alternative Asbestos Control Method is equal to or less than the post-demolition asbestos concentration in the soil from the Asbestos NESHAP Method if:

$$T > t_{18}(0.95) = 1.7341$$

where the statistic T is computed using the natural logarithms of the measured asbestos soil concentrations. As for the airborne measurements, nondetect values will be assigned a soil concentration one-half that corresponding to a single measured fiber. A sensitivity analysis will also be performed as described for the airborne asbestos measurements (see Section A7.1.6 "*Tolerable Limits on Decision Errors*"). Under the alternative hypothesis that the post-excavation asbestos concentration in the soil from the Alternative Asbestos Control Method is greater than the Asbestos NESHAP Method, the statistic T has a noncentral t distribution with 14 df and noncentrality parameter:

$$\delta = 2.24(\mu_2 - \mu_1)/\sigma$$

where $e^{\mu 1}$ (respectively, $e^{\mu 2}$) is the geometric mean asbestos soil concentration for the Alternative Method (respectively, the NESHAP Method), and σ is the standard deviation for the underlying normal distribution. We will assume that the value $\sigma = 1.29$, used for the power calculations for the airborne asbestos comparison, is also conservative for the soil comparison. After all, variability in the wind direction is the primary contributor to the variability in airborne levels. This source of variability is far less relevant to the soil comparison. Table A-9 shows the results of the power calculation for a range of values of σ less than or equal to 1.29, for various values of the ratio of the geometric mean for the Alternate Method, GM(A), to the geometric mean for the NESHAP Method, GM(N)

Table A-8. Power of Two-Sample t-Test for Soil Comparison

	σ				
GM(A)/GM(N)	**0.25**	**0.50**	**0.75**	**1.00**	**1.25**
2	>0.999	0.91	0.64	0.44	0.33
3	>0.999	0.999	0.93	0.76	0.60
5	>0.999	>0.999	0.999	0.97	0.87
7	>0.999	>0.999	>0.999	0.99	0.96
10	>0.999	>0.999	>0.999	>0.999	0.99

Thus, for moderate values of σ less than or equal to 0.75, a 3-fold difference between geometric mean soil concentrations for the Alternative and NESHAP Methods has a high probability of detection by the two-sample t-test based on 10 samples per containment berm of each building. Even with a conservative estimate of variability ($\sigma = 1.25$), a 5-fold difference between methods has an 87% probability of being detected.

A7.2.7 Step 7: Optimize the Design for Obtaining Results

The sample design allows conclusions to be drawn about the entire area sampled within the containment-berm, which is consistent with the project objective. That is, the area within the containment berm will be separated by using an equally-dimensioned 10-part grid system. The sampling points for each of the ten components that comprise the composite sample will be randomly selected.

A7.2.8 Analytical Sensitivity

The soil samples will be analyzed by using EPA Method 600/R-93/116 (July 1993) "*Method for the Determination of Asbestos in Bulk Building Materials.* This method has an analytical sensitivity of 0.1%.

A7.2.9 Data Quality Indicators (DQI)

A7.2.9.1 Sample Collection DQI

- Precision: Interleaved composite sampling will minimize the variability in sample concentrations.

- Completeness: The project goal is to collect 100 percent of the samples specified in the sample design. If completeness objectives are not met the effect on conclusions will be evaluated.

- Representativeness: Composite sampling of the soil using a 10-part equally-dimensioned grid system is intended to be representative of the soil within the containment berm.

- Comparability: Consistent sampling and analytical approaches for pre-demolition, post-demolition, and post-excavation sampling events will ensure comparability.

A7.2.9.2 Sample Analysis DQI

REI will be the principal analytical laboratory and RTI will be the QC laboratory. See Section B5 regarding the QA/QC criteria for the analytical method data quality indicators (DQI).

A7.3 Third Primary Objective

To determine if the Alternative Method is more cost-effective than the NESHAP Method considering all costs, including disposal of all asbestos-contaminated debris and soils, and projected costs for enforcement.

A7.3.1 Step 1: State the Problem

Asbestos removal in accordance with the asbestos NESHAP can account for a significant portion of the total demolition costs. In many cities, the cost of pre-demolition asbestos removal prohibits the timely demolition of substandard structures that are not in danger of imminent collapse but which, if left standing, could become structurally unsound over a period of years. If the Alternative Asbestos Control Method proves to be less expensive than the current demolition requirements of the Asbestos NESHAP, the demolition of many abandoned buildings around the nation that remain standing and currently present a variety of potentially serious risks to nearby residents may be accelerated. Although the cost of disposal is higher using the Alternative Asbestos Control Method, the overall costs are potentially lower.

A7.3.2 Step 2: Identify the Decision

Is the Alternative Method more cost-effective than the NESHAP Method considering all costs, including disposal of all asbestos-contaminated debris and soils, and projected costs of enforcement?

A7.3.3 Step 3: Identify Inputs to the Decision

Information that is required to resolve the decision statement:

- Accurate and reliable information on the cost of all labor, materials, and supplies to perform the pre-demolition removal of RACM (i.e., gypsum wallboard and glazing compound) from the NESHAP Method Building. These costs include: preparation of asbestos abatement specifications by a licensed Asbestos Project Designer; removal of the RACM by a licensed asbestos abatement contractor; oversight of the abatement, worker exposure monitoring (asbestos and lead), and clearance testing by a licensed asbestos consultant; transportation and disposal of the RACM to a licensed asbestos disposal facility.

- Accurate and reliable information on the cost of all labor, materials, and supplies to perform the post-abatement demolition of the NESHAP Building. These costs include: demolition of the structure, transportation and disposal of the construction debris, and grading for future use.

- Accurate and reliable information on the cost of all labor, materials, and supplies to demolish the Alternative Method Building. These costs include: pre-demolition wetting of the structure; demolition of the structure using asbestos-trained workers and NESHAP-trained observers; personal protective equipment and OSHA-mandated monitoring for asbestos and lead; transportation and disposal of all construction debris as asbestos-containing waste at a licensed landfill; post-demolition excavation of soil; and transportation and disposal of soil as asbestos-containing waste at a licensed landfill.

- Accurate and reliable information on the cost of all federal, state, and local enforcement activities relative to each method of demolition and disposal.

A7.3.4 Step 4: Define the Study Boundaries

Spatial boundary of the decision statement: This decision related to all cost for labor, materials, and supplies associated with the asbestos abatement, demolition, disposal, and enforcement of the NESHAP Method Building (#3602); and all cost for labor, materials, and supplies associated with the demolition, disposal, and enforcement of the Alternative Method Building (#3607). The costs will be specific for this project at this location. Costs at other locations are expected to be site-specific.

A7.3.5 Step 5: Develop a Decision Rule

If the total cost to demolish and dispose of the construction debris and soil, as well as projected enforcement costs from the Alternative Method Building is less than the abatement, demolition, and disposal, and projected enforcement costs of the NESHAP Method Building, then the Alternative Method is more cost-effective than the NESHAP Method.

A7.3.6 Step 6: Tolerable Limits on Decision Errors

The total costs for both methods will be documented. No limits on decision errors are needed.

A7.3.7 Step 7: Optimize the Design for Obtaining Results

The design is based on a thorough and complete documentation of all costs.

A8 SPECIAL TRAINING REQUIREMENTS/CERTIFICATION

A8.1 Field Personnel

Two separate field teams will support the project: one team will be assigned to the Fort Chaffee demolition site and the other team to the City of Fort Chaffee landfill. Both teams will be headed by an American Academy of Industrial Hygiene ABIH-Certified Industrial Hygienist. Each team leader has extensive experience in conducting asbestos-related field research studies including those related to building demolitions (see Figure A-1). An ADEQ-licensed Asbestos Abatement Consultant with training in the Asbestos NESHAP (40 CFR Part 61, Subpart M) will be on site during demolition and debris loading activities to document the release of any visible emissions as well as oversee the demolition process. Other field personnel will also have experience in asbestos ambient air monitoring, occupational exposure monitoring, related environmental measurements, and data recording. The field personnel will be trained in the requirements of the site-specific Health and Safety Plan (HASP).

A8.2 Laboratory Personnel

<table>
<tr><th colspan="2">Primary Laboratories</th><th>Quality Control Laboratory</th></tr>
<tr><td>MVA Scientific Consultants
3300 Breckinridge Blvd., Suite 400
Duluth, GA 30096
Contact: James Millette, Ph.D.
(770) 662-8509

Asbestos, air (TEM)
Total fibers (PCM)</td><td>Reservoirs Environmental, Inc.
2059 Bryant Street
Denver, CO 80211
Contact: Jeanne Spencer Orr
(330) 964-1986

Asbestos, settled dust (TEM)
Asbestos, soil (PLM and TEM) and water (TEM)
Lead, air (ICP-AES)</td><td rowspan="2">RTI International
3040 Cornwallis Road
Research Triangle Park, NC 26609
Contact: Michael Beard
(919) 541-6489
Owen Crankshaw
(919) 541-7470

Asbestos, air (TEM)
Asbestos, soil (PLM and TEM)
Asbestos, setteed dust (TEM)</td></tr>
<tr><td>DataChem Laboratories, Inc.
4388 Glendale-Milford Road
Cincinnati, OH 45249
Contact: Jim Baxter
(513) 733-5336

Lead, demolition debris and soil (TCLP)</td><td>Lab/Cor, Inc.
7619 6th Avenue, NW
Seattle, WA 98117
Contact: John Harris
(206) 781-0155

Asbestos, Soil elutriation (TEM)</td></tr>
</table>

A9 DOCUMENTATION AND RECORDS

A9.1 Field Operations Records

A9.1.1 Sample Documentation

The following information will be recorded on Sampling Data Forms (Figures A-8 through A-12), as applicable:

- Name(s) of person(s) collecting the sample;
- Date of record;
- Description of sampling site (e.g., Building #3602, #3607, Fort Smith Landfill);
- Description of sample including a photographic image showing the sample number;
- Location of sample documented on site map with GPS coordinates, as applicable;
- Type of sample (e.g., area, personal, settled dust, soil, water, duplicate, field blank);
- Unique sample number that identifies the sampling site, sample type, date, and sequence number;
- Flow meter number and airflow reading (start/stop);
- Sample time (start/stop) recorded in military time;
- A pre-printed sheet of sample labels (2 identical labels per sample number) will be prepared. One label will be attached to the sample container before sample collection period begins, and the other matching label will be attached to the field data sheet that records relevant data on the sample being collected.
- Relevant notes describing site observations such as, but not limited to, site conditions, weather conditions, demolition and debris handling equipment, water application technique (spray or concentrated stream), equipment problems, etc. The notes will be recorded in a bound notebook.

Pumps checks will be performed at least every 2 hours during sample collection. These periodic checks will include the following activities:

- Observe the sampling apparatus (filter cassette, vacuum pump, etc.) to determine whether it's been disturbed.
- Check the pump to ensure that it is working properly and the flow rate is stable at the prescribed flow rate.
- Inspect the filter for overloading and particle desposition.

At the end of each day, all samples and the corresponding Sampling Data Forms will be submitted to the Team Leader at the demolition site or landfill. The Team Leader will verify 100% of the information recorded on the Sampling Data Form for completeness and that all samples are in custody; any discrepancy will be resolved and corrections will be noted, initialed, and dated on the form.

ENVIRONMENTAL QUALITY
MANAGEMENT, INC.

Building No:	
Location:	
Date:	
Page:	of

GPS Coordinates	Ring No.	Sample Ht, ft.	Sample No.	Pump No.	Flow Meter No.	Flow Rate, lpm			Time		Duration, min.	Air volume, liters
						Start	Stop	Avg.	Start	Stop		
									:	:		
									:	:		
									:	:		
									:	:		
									:	:		
									:	:		
									:	:		
									:	:		
Entries by:			Calculations by:						Checked by:			

Figure A-8. Sampling Data Form—Air

ENVIRONMENTAL QUALITY MANAGEMENT, INC.

Building No.: ____________

Date: ____________

Page: ______ of ______

Entries by: ____________

Sample Number	Sample Type Soil	Sampling Locations	Sample Time	Field Comments

Figure A-9. Sampling Data Form – Soil

ENVIRONMENTAL QUALITY MANAGEMENT, INC.

Building No.: ____________________

Date: ____________________

Page: __________ of __________

Entries by: ____________________

Sample Number	Sample Type Water	Sample Locations	Sample Time	Field Comments

Figure A-10. Sampling Data Form – Water

ENVIRONMENTAL QUALITY
MANAGEMENT, INC.

Building No.: ____________
Date: ____________
Page: ______ of ______
Entries by: ____________

Sample Number	Ring No.	Sample, Ht., ft.	GPS Coordinates (Location on site map)	Sample Time		Field Comments
				Start	Stop	

Figure A-11. Sampling Data Form – Settled Dust

ENVIRONMENTAL QUALITY MANAGEMENT, INC.

Building No.:	
Landfill:	
Date:	
Page:	of

Weather Station Measurement Log

Time	Wind Speed, MPH	Wind Direction	Barometric Pressure, In. Hg	Temperature, °F	Relative Humidity, %

Figure A-12. Meteorological Measurement Log

A9.1.2 Meteorological Measurements

Met One Instruments, Inc., meteorological stations will record temperature, barometric pressure, relative humidity, wind speed, and wind direction at 5-minute averages. The data files will be downloaded by using an on-site personal computer. These same metrics will also be noted from the instrument's visual display and recorded on a Meteorologic Data Measurement Log (Figure A-12) at least hourly.

A9.1.3 Photo Documentation

A digitized image will be taken of every sampling location. This will include the sampling station and visual debris on or in the soil. A 5-inch by 7-inch index card (or equivalent) listing the sample number will be photographed to identify the sample and location. Other digitized images will be taken as necessary to thoroughly document the site conditions (such as "visible emissions," if such occur) and activities. In addition, a camcorder will be used to videotape the demolition and demolition debris landfilling operations.

A9.2 Chain-of-Custody Records

Standard EQ sample traceability procedures described in Section B3 will be used to ensure sample traceability.

A9.3 Laboratory Records

Complete data packages will be submitted for all sample analyses (i.e., asbestos and total fibers) for all matrices (air, soil, settled dust, and water). This information will be submitted in sufficient detail to allow the subsequent verification of the reported analyses. Alternative forms routinely used by the laboratories may be substituted for those forms specified in the referenced methods. The laboratory data package will meet the guidelines in *Laboratory Documentation Requirements for Data Evaluation* (R9/QA/004.1), EPA, March 2001.

A9.3.1 TEM Reporting (Air)

Specifically for TEM analysis the following is required:

- Structure counting data shall be recorded on forms equivalent to the example shown in ISO 10312:1995.

- The test report shall contain items (a) to (p) as specified in Section 11, "Test Report," of ISO 10312:1995. In addition, the files containing the raw data (in Microsoft Excel format) shall be submitted. The format of these files shall be as directed by the project manager, but shall contain the following items:

  1. Laboratory Sample Number
  2. Project Sample Number
  3. Date of Analysis
  4. Air Volume
  5. Active Area of Sample Filter
  6. Analytical Magnification
  7. Mean Grid Opening Dimension in mm^2
  8. Number of Grid Openings Examined
  9. Number of Primary Structures Detected
  10. One line of data for each structure, containing the following information as indicated in Figure 7 "Example of Format for Reporting Structure Counting Data" of ISO 10312:1995, with the exception that the lengths and widths are to be reported in millimeters as observed on the screen at the counting magnification:

      - Grid Opening Number
      - Grid Identification
      - Grid Opening Identification/Address
      - Structure or Sub-structure Number
      - Asbestos Type (Chrysotile or Amphibole)
      - Morphological Type of Structure (fiber, bundle, matrix, cluster)
      - Length of Structure in 1-mm increments (e.g., 32)
      - Width of Structure in 0.1-mm increments (e.g., 3.2)
      - Any Other Comments Concerning Structure (e.g., partly obscured by grid bar)

A9.3.2 TEM Reporting (Soil)

In addition to the applicable requirements noted in Section A9.3.1 the primary soil analysis laboratory will provide data (electronic and hard copy) as specified in EPA Method 600/R-93/116 (July 1993) "*Method for the Determination of Asbestos in Bulk Building Materials.*"

B MEASUREMENT/DATA ACQUISITION

B1 BUILDING DEMOLITION

B1.1 Air Dispersion Modeling

This section presents the modeling approach used to assist in the placement of ambient air monitors that will be used to measure the concentration of airborne asbestos fibers during the demolition of the NESHAP (#3602) and Alternative Method (#3607) Buildings and associated demolition activities. Results of the modeling were used as a predictive tool to evaluate possible monitoring locations, both laterally (x, y) as well as vertically (z), around these buildings.

B1.1.1 Source Identification

The sources identified for purposes of this modeling consist primarily of two major operations taking place during the demolition activities: 1) the actual demolition of the building itself and 2) the loading of the truck bed with demolition debris. These two operations will be occurring simultaneously and have the potential to release dust and other airborne particulate matter to the atmosphere. Therefore, both were included in the modeling analysis to account for their potential contributions. The following describes in further detail the characterization of these sources.

B1.1.1.1 Source No.1: NESHAP/Alternative Method Building Demolition

Figure B-1 is a photograph of the type of building to be demolished as part of the NESHAP and Alternative Methods. The building is approximately 30 feet wide, 150 feet long, and 15 feet high.

A demolition grappler will be used to remove finite sections of the building and then transfer the debris to a large open-bed truck. The demolition process will start at one end of the building and work its way down along the length of the building. The source defined in this case is associated with the extraction of sections of the building being demolished by the grappler prior to loading the debris onto the truck.

Figure B-1. Configuration of the Type of Building to be Demolished

B1.1.1.2 Source No. 2: Transfer of Building Demolition Debris Into Truck Bed

Figure B-2 is a photograph of a grappler loading extracted material from a demolition site into a truck bed. As shown in the figure, the grappler has extracted a section of a building and is unloading the debris into the back of a truck. The source defined in this case is associated with the potential emissions resulting from the transfer of the extracted material into the bed of the truck.

B1.1.1.3 Model Selection

Two U.S. EPA-approved models, SCREEN3 and the Industrial Source Complex Model, Version 3, in its short-term mode (ISCST3), were considered for use in this analysis. Both models are based on a steady-state Gaussian plume algorithm, and are applicable for estimating ambient impacts from point, area, and volume sources out to a distance of about 50 kilometers.

B1.1.1.4 Source Characterization

Due to the nature and extent of the building demolition process, both of these sources are most appropriately modeled as volume sources. A volume source is used to model emissions

Figure B-2. Transfer of Building Debris to Truck Bed

that initially disperse three-dimensionally with no plume rise. These sources can either be surface based, structure based (elevated sources on or adjacent to a structure), or elevated (elevated sources not on or adjacent to a structure). Typical volume sources include side or roof building vents, conveyor transfer points, emissions from a crusher or screen, and emissions from loading and unloading trucks.

The inputs for modeling a volume source include the following:

- Emissions rate (g/s)
- Initial lateral dimension of the volume source (σyo)
- Initial vertical dimension, initial depth of the volume source (σzo)
- Release height (m).

Table B-1 summarizes these inputs for the building demolition and truck loading activities:

B1.1.1.5 SCREEN3 Model

SCREEN3 is the U.S. EPA's current regulatory screening model for many New Source Review (NSR) and other air permitting applications. The SCREEN3 model utilizes a predefined

Table B-1. Summary of Selected Volume Source Modeling Parameters

Parameter	Source		Basis/Comment
	Bldg. Demolition[1]	Truck Loading[2]	
Emission Rate (g/s)	1 g/s	1 g/s	Unit Emission Rate
Init. Lateral Dim. (σyo)	0.70 ft	0.70 ft	Defined based on model guidance for ISCSTS[3]
Init. Vertical Dim. (σzo)	6.98 ft	1.4 ft	
Release Height (m)	7.5 ft	--	Avg. Height of Bldg. (15 ft/2 = 7.5 ft)
	--	7, 12, 15 ft	Based on multiple drop distances to truck bed.

[1] Parameters based on size of grappler (assuming 3 ft x 3 ft) and a building height of 15 ft.

[2] Parameters based on size of grappler (assuming 3 ft x 3 ft), height of side wall of truck bed, and a release height evaluated at 7 ft, 12 ft, and 15 ft.

[3] U.S. EPA, *User's Guide for the Industrial Source Complex (ISC3) Dispersion Models: Volume 2 – Description of Model Algorithms*, September 1995 (EPA-454/B-95-003b), Table 6-1 "Summary of Suggested Procedures for Estimating Initial Lateral Dimensions and Initial Vertical Dimensions for Volume and Line Sources". Refer to the following assumptions described below:

Initial Lateral Dimension for both sources:
Based on size of grappler (assuming 3 ft x 3 ft), where for single volume source, is equivalent to length of side divided by 4.3. Thus σy_o = 3 ft / 4.3 = 0.70 ft for both source types.

Initial Vertical Dimension for both sources:
Building Demolition: For an elevated source on or adjacent to a building, the initial vertical dimension is equivalent to the building height divided by 2.15. Thus σz_o = 15 ft / 2.15 = 6.98 ft.

Truck Loading: For an elevated source not on or adjacent to a building, the initial vertical dimension is equivalent to the vertical dimension of the source divided by 4.3. Thus σz_o = 3 ft / 4.3 = 0.70 ft (Assuming the vertical dimension of the grappler is 3 ft).

matrix of meteorological conditions that cover a range of wind speeds and stability categories (A through F), where the maximum wind speed is stability-dependent. The model is designed to estimate the worst-case impact based on a defined meteorological matrix for use as a "conservative" screening technique.

In order to determine the relative extent of impact due to these operations, the SCREEN3 model was used to assess the impacts from the building demolition and truck loading sources defined previously. In lieu of actual emissions data, a unit emission rate of 1 g/s was assigned to each of the two sources. Impacts from these sources were modeled from the source origin out to a distance of 1,000 feet. Receptors were spaced every 5 feet out to 100 feet, then every 100 feet thereafter until reaching a distance of 1000 feet. In addition to the ground level impacts, SCREEN3 has the capability to model elevated (free standing) receptors, called flagpole receptors. Therefore, to assess the potential impacts from these sources at elevations above ground level, flagpole receptors were modeled at heights of 5, 10, and 15 feet.

Results of the SCREEN3 modeling associated with the building demolition activities for each of the flagpole heights are shown in Figures B-3 and B-4. Figure B-3 shows the resulting change in concentration as a function of distance from this source out to a distance of 1000 feet. As shown in Figure B-3, peak concentrations occur within the first 50 feet of the source and rapidly taper off as distance from the source increases. Figure B-4 presents the same profile from the source out to 100 feet. Figure B-4 shows that the peak concentration from the building demolition source is predicted to occur within 10 feet of the source.

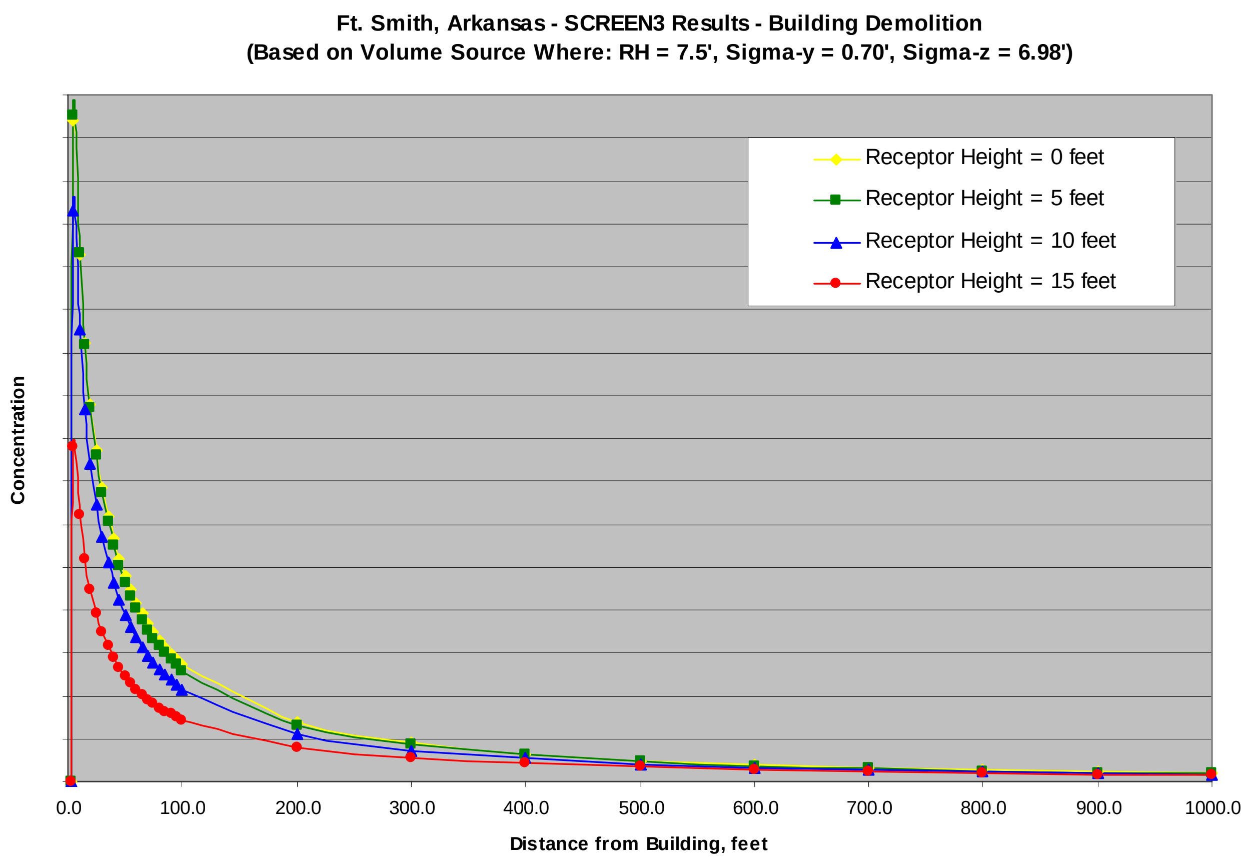

Figure B-3. SCREEN3 Results for Building Demolition Source (0 to 1,000 feet)

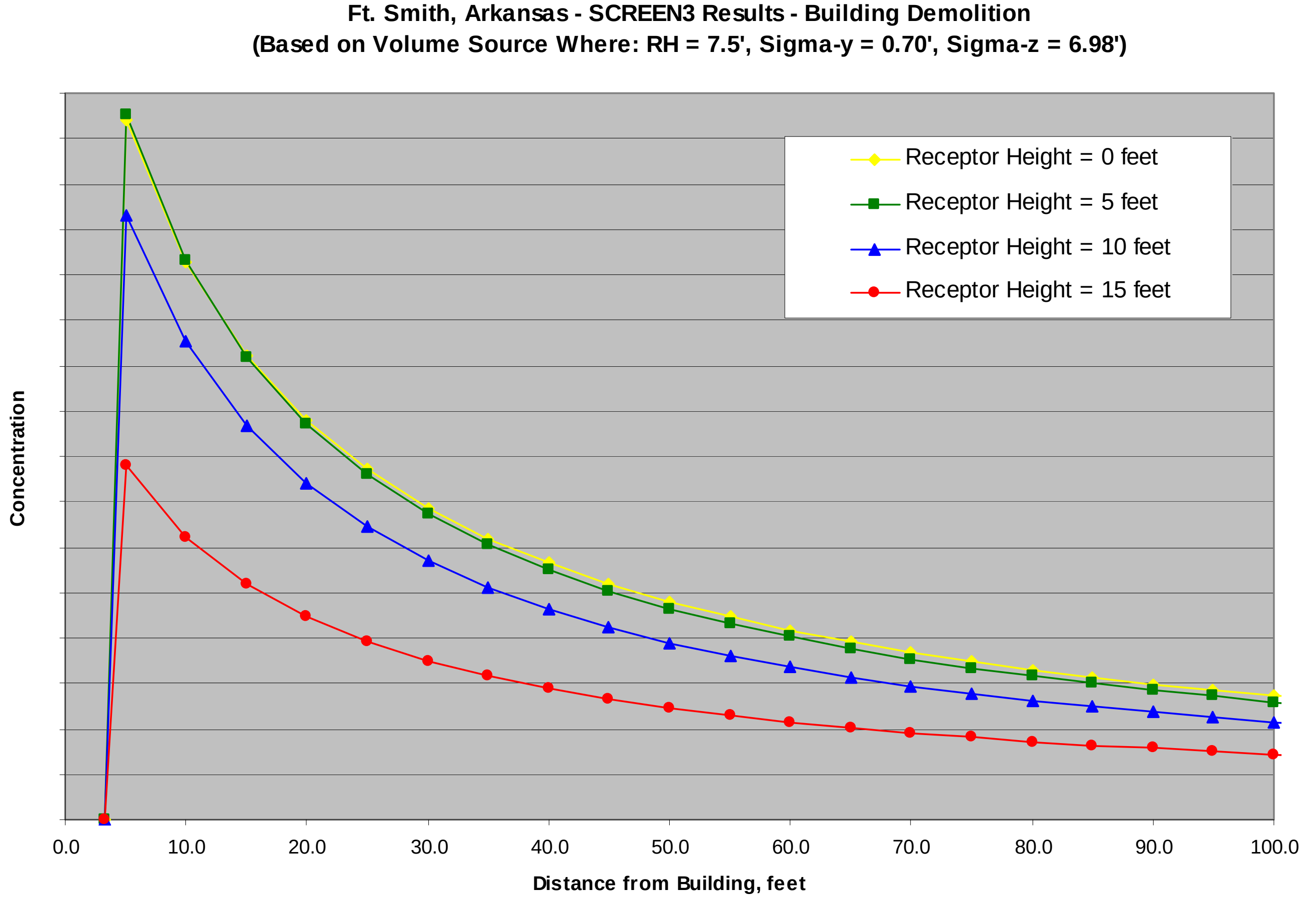

Figure B-4. SCREEN3 Results for Building Demolition Source (0 to 100 feet)

A similar procedure was used to assess the SCREEN3 results for the truck loading source. Figures B-5, B-6, and B-7 displays the predicted concentration profiles as a function of distance for source release heights of 7, 12, and 15 feet. Multiple source release heights were evaluated because as the bed of the truck becomes full, the distance that the material will drop can change. The data from these figures also shows that the maximum/peak concentrations, regardless of release height, occur within 15 feet of the source origin.

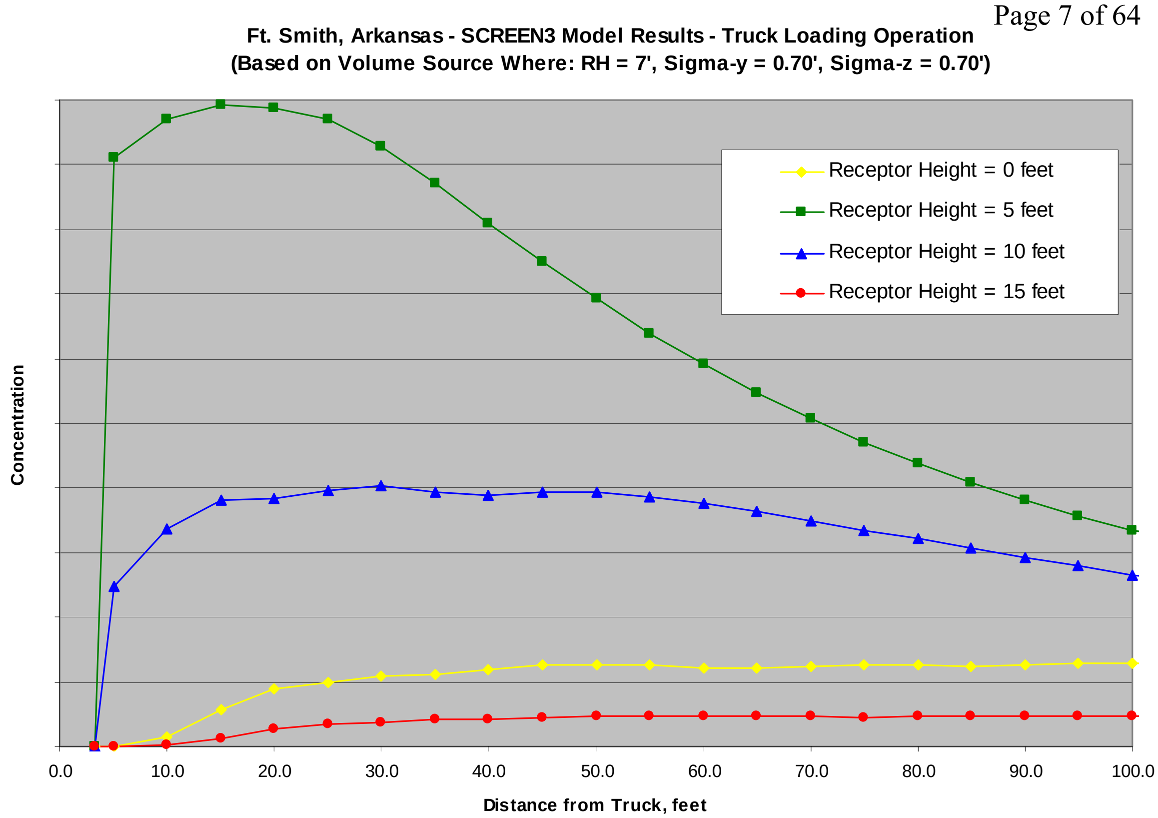

Figure B-5. SCREEN3 Results for Truck Loading Source (Release Ht =7 ft)

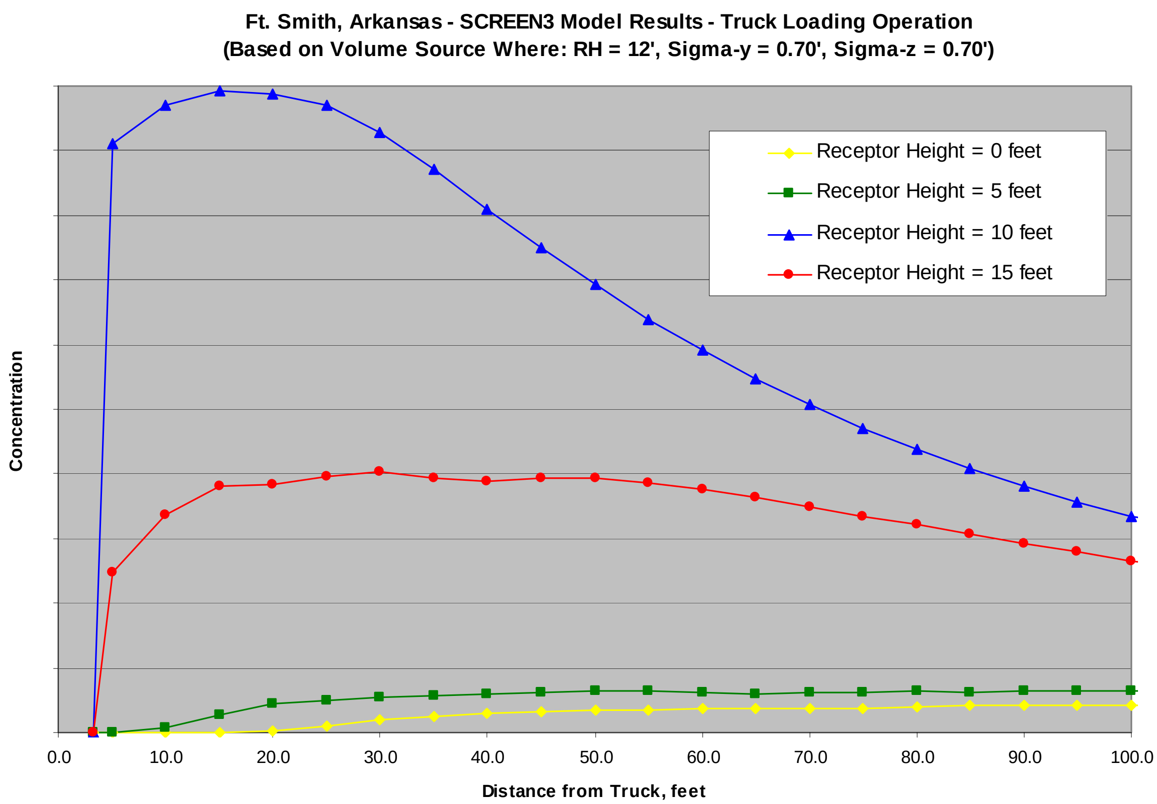

Figure B-6: SCREEN3 Results for Truck Loading Source (Release Ht =12 ft)

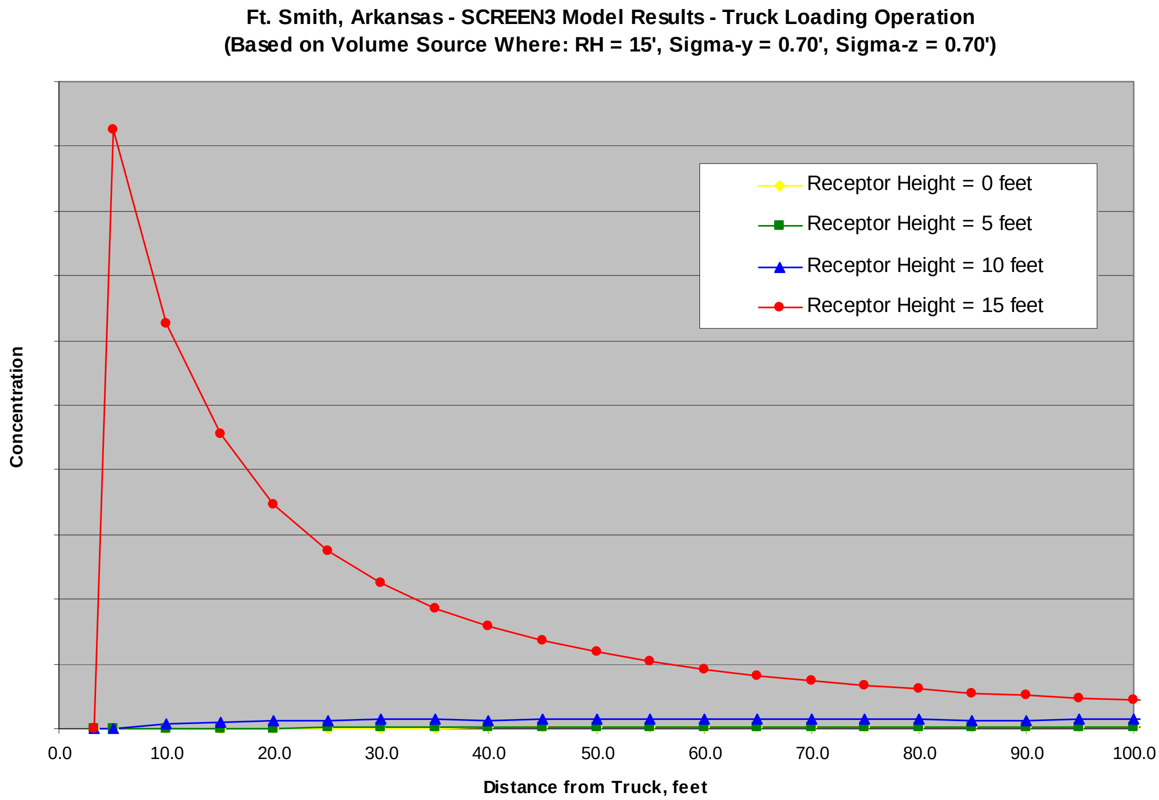

Figure B-7. SCREEN3 Results for Truck Loading Source (Release Ht =15 ft)

B1.1.1.6 ISCST3 Model

The ISCST3 model is a more refined model (as compared to SCREEN3) and utilizes actual hourly meteorological data that have been preprocessed using U.S. EPA's PCRAMMET program for compiling National Weather Service (NWS) meteorological data. Preprocessed meteorological data from the Ft. Smith area consisting of representative surface meteorological observations for Ft. Smith Municipal Airport (NWS No.13964) and upper air twice-daily mixing height data from North Little Rock, AK (NWS No.13963) for use in the ISCST3 model were obtained for the period 1999 through 2004. Figure B-8 shows a wind rose depicting the wind patterns for this area.

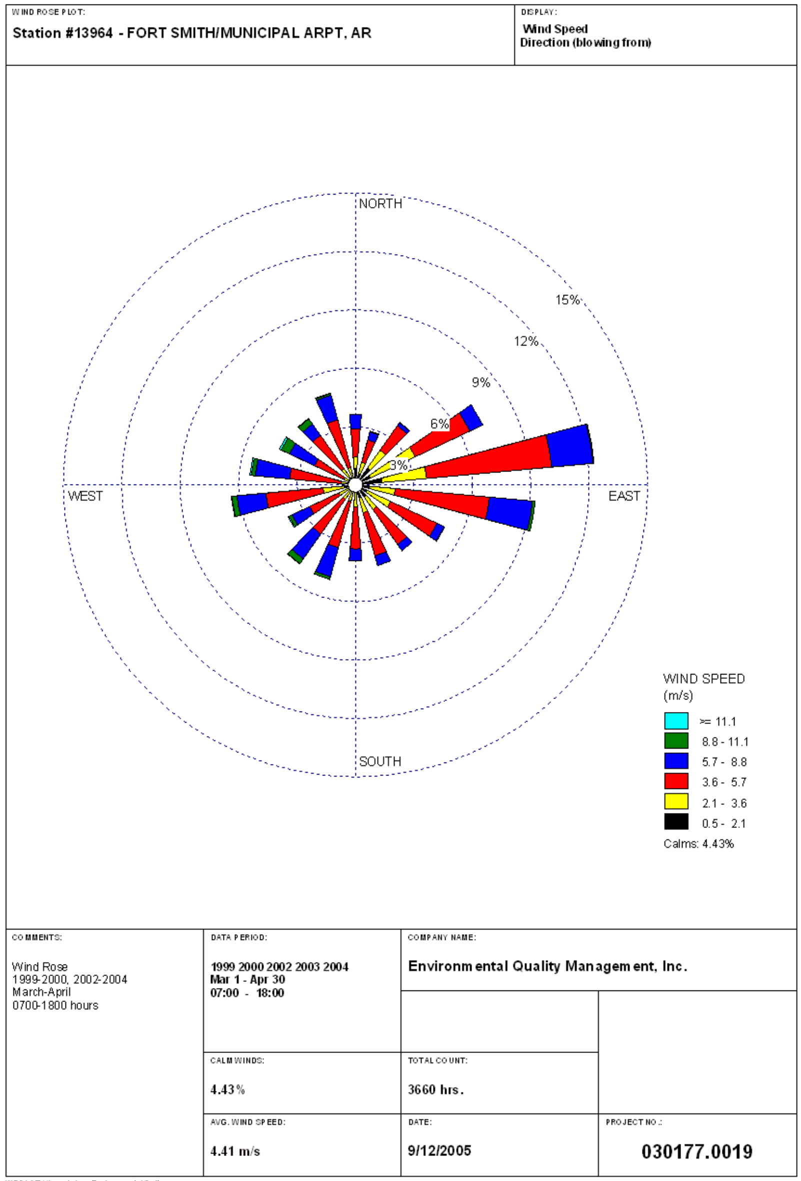

Figure B-8. Wind Rose for the Period 1999-2000 and 2002-2004

The wind rose depicted in Figure B-8 for the period 1999-2000 and 2002-2004 shows a fairly even distribution of winds throughout the 18 wind sectors evaluated with some dominant winds blowing from the east. This data depicts the March-April months for all years evaluated and is representative of the daily time frame of 0700 hours through 1800 hours, the period during which all demolition and truck-loading activities will take place.

Based on this data, the ISCST3 Model was run for years 1999-2000 and 2002-2004 for the sources operating from 0700 to 1800 hours during the months of March and April. An example of the results from the ISCST3 modeling for the building demolition source are depicted in Figure B-9 for the most recent meteorological year – 2004 at a receptor height of 5 meters. This isopleth shows that for year 2004, maximum concentrations due to building demolition activities still occur close to the source (consistent with the SCREEN3 results) and that within 100 meters, the modeled concentration drops to approximately 2-5% of the maximum modeled concentration near the source origin. This was consistent for all years modeled and for both sources evaluated (the building demolition and the truck loading).

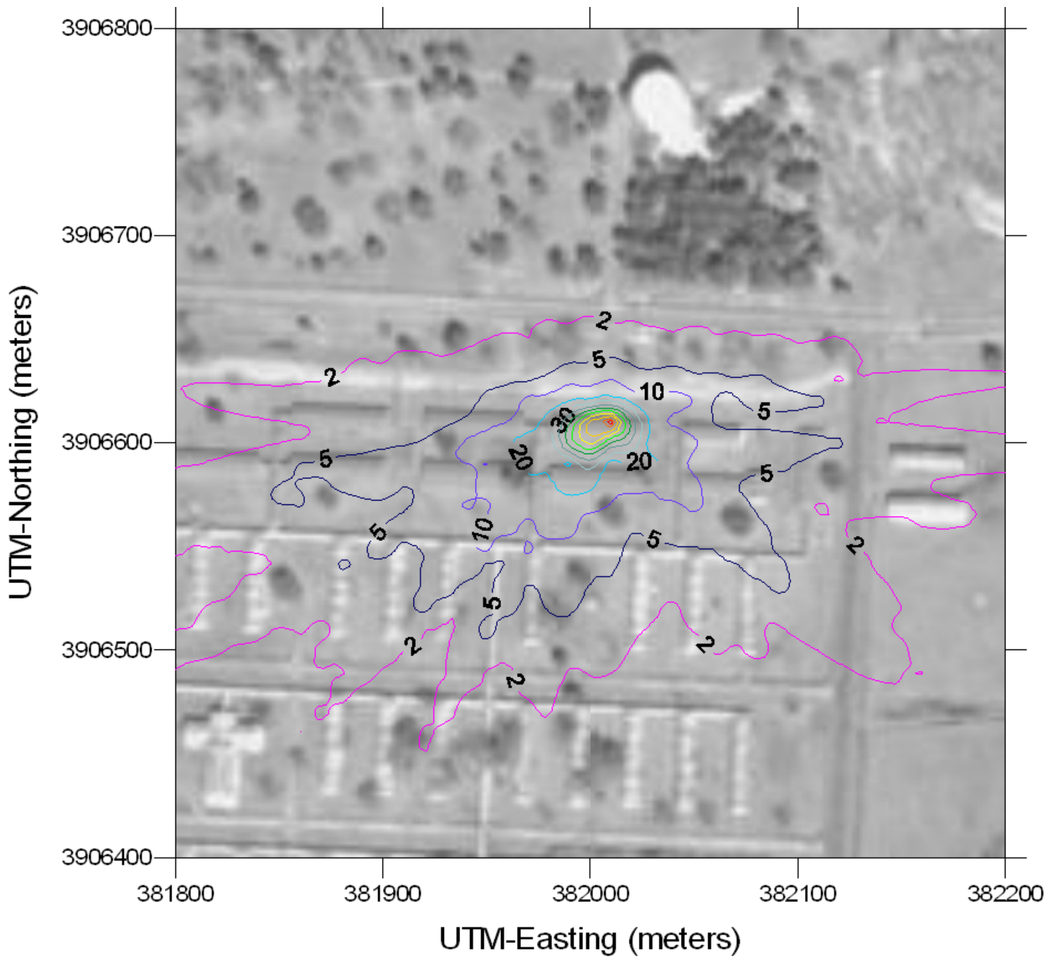

Figure B-9. Results of ISCST3 Model Run for Year 2004 Represented as Percent of Total Maximum Concentration for Building Source

B1.2 Monitoring During Demolition

B1.2.1 Perimeter Air Monitoring During Demolition

Modeling conducted using the EPA dispersion models SCREEN3 and ISCST3 indicates that the maximum airborne asbestos concentrations during demolition and loading of debris will most likely occur approximately 15 feet from the building and during loading activities at a height of five feet above the ground. Therefore, the comparison of airborne asbestos concentrations from the NESHAP and Alternative Control Methods will be based on measurements from monitors placed five feet above ground in a ring (the "primary ring") approximately 15 feet from the face of each building or as close as possible to the demolition or debris loading areas. *Note:* On the north side of the building the monitors in the primary ring will be positioned approximately 25 feet from the face of the building to accommodate the space needed for disposal truck or equivalently approximately 10 feet from north face of truck. The monitors will be placed at even intervals around each building. An additional set of monitors will be positioned at a height of 15 feet in the primary ring directly above the 5-foot-high monitors. If the asbestos concentrations measured at the 15-foot-high monitors are larger than those observed at the 5-foot height for both the NESHAP and the Alternative Control Method Buildings, then the 15-foot-high values will be used for the primary assessment; see Section B10.3.1 regarding the proposed approach for statistical analysis of the data. *Note:* The perimeter air monitors will be placed immediately outside of the containment berm.

Monitors will also be located to collect additional asbestos data necessary for potential future air dispersion modeling efforts. Monitors will be placed 5 feet above ground at even intervals in each of two additional rings: one approximately 50 feet from the building and the other approximately 100 feet from the building.

The perimeter air monitoring network consisting of the three concentric rings is shown for the NESHAP and Alternative Control Buildings in Figures B-10 and B-11, respectively. The estimated number of air samples to be collected and analyzed for asbestos is summarized in Table B-2. To avoid overloading of the filters with particulate, air sampling will be conducted for two sequential periods during each workday. It is assumed that the demolition, construction debris loading, and site grading will occur over one day. All samples will have a target air volume of 1,920 to 2,400 liters.

Table B-2. Perimeter Air Monitoring Samples for Asbestos Analysis[a] During Demolition and Debris Loading

Ring	Sample Type	Number of Samples				Total Samples
		NESHAP Method		Alternative Method		
		Period 1	Period 2	Period 1	Period 2	
R1@ 5-ft	Sequential 4-5 hr period	18	18	18	18	72
	Duplicates	2	2	2	2	8
	Open field blank	1	1	1	1	4
	Closed field blank[b]	1	1	1	1	4
	Total Samples	22	22	22	22	88
R1@ 15-ft	Sequential 4-5 hr period	18	18	18	18	72
	Duplicates	2	2	2	2	8
	Open field blank	0	0	0	0	0
	Closed field blank	0	0	0	0	0
	Total Samples	20	20	20	20	80
R2@ 5-ft	Sequential 4-5 hr period	18	18	18	18	72
	Duplicate	1	1	1	1	4
	Open field blank	1	1	1	1	4
	Closed field blank	1	1	1	1	4
	Total Samples	21	21	21	21	84
R3@ 5-ft	Sequential 4-5 hr period	18	18	18	18	72
	Duplicate	1	1	1	1	4
	Open field blank	1	1	1	1	4
	Closed field blank	1	1	1	1	4
	Total Samples	21	21	21	21	84
	TOTAL SAMPLES					**336**

[a] Samples will be analyzed both for asbestos (ISO 10312:1995) and total fibers (NIOSH 7400, A Rules).
[b] Closed field blanks will only be analyzed if asbestos contamination is detected on the open field blanks.

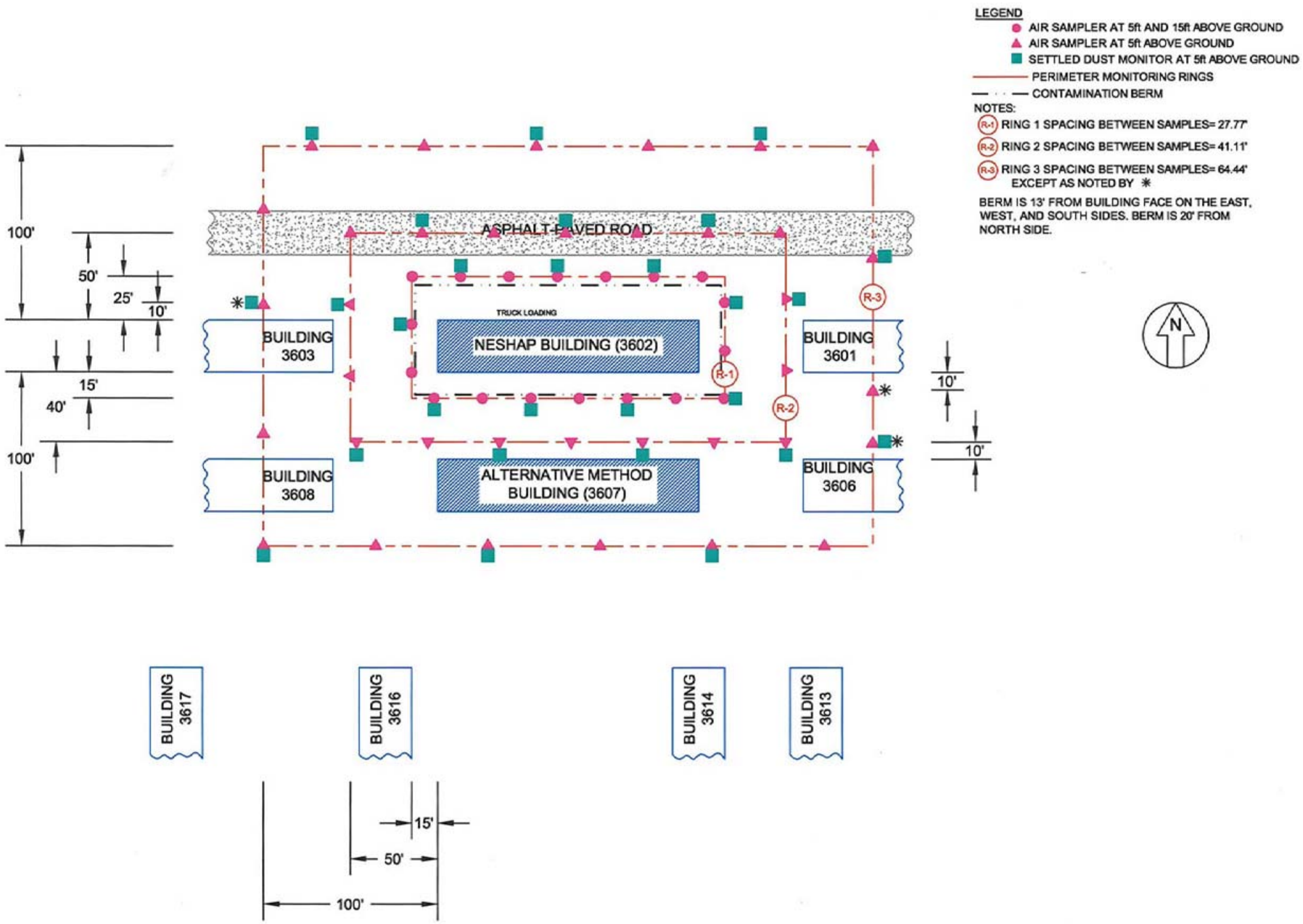

Figure B-10. Locations of Air Monitors around the NESHAP Building

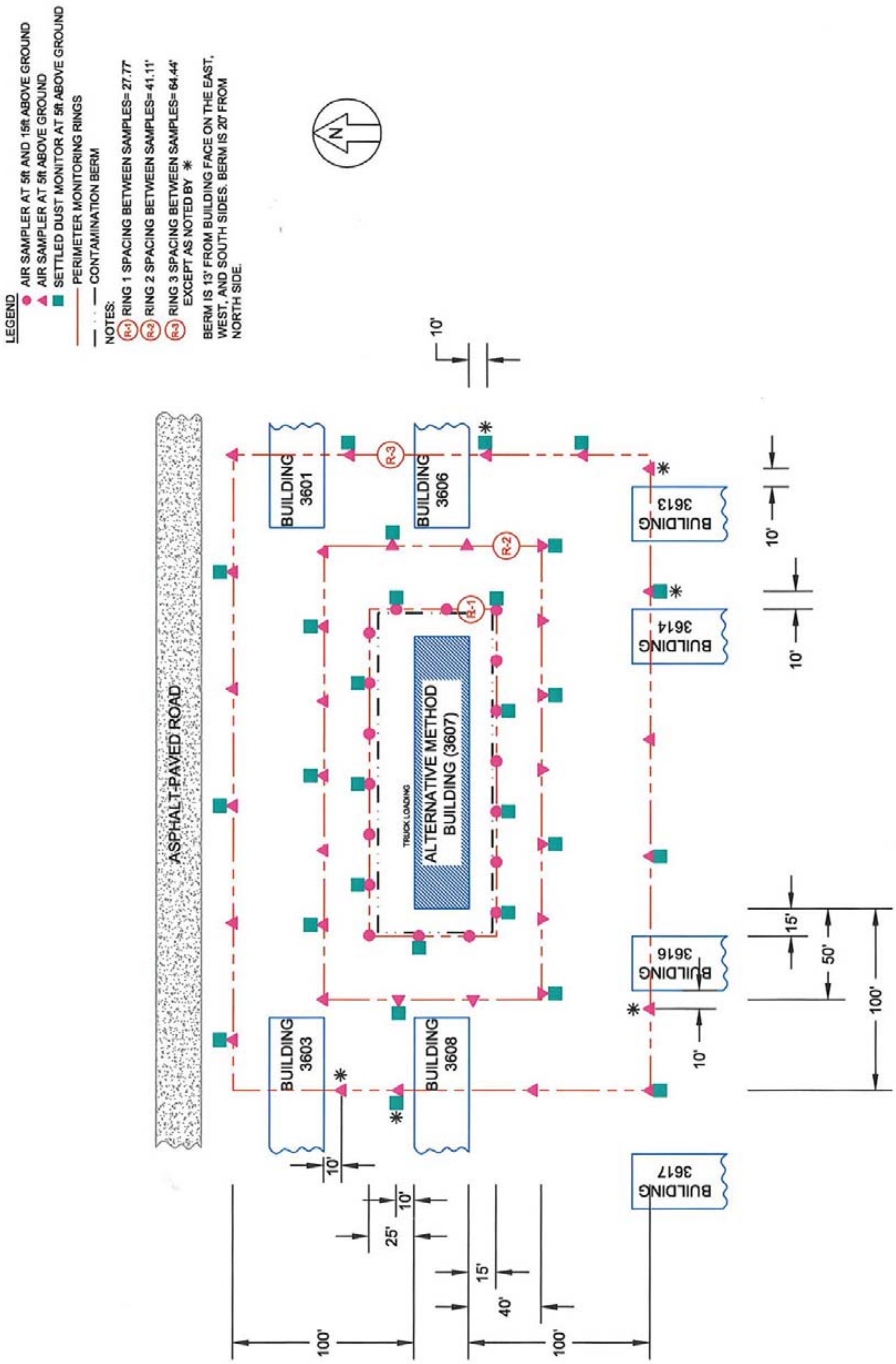

Figure B-11. Locations of Air Monitors around the Alternative Method Building

B1.2.2 Worker Exposure Monitoring During Building Demolition

Personal breathing zone samples will be collected from all workers directly involved with the demolition of the building and the handling of the resultant construction debris. Personal samples for asbestos will be collected during the two sampling periods (morning and afternoon). to calculate the time-weighted average concentration for comparison to the OSHA Permissible Exposure Limit for Asbestos (29 CFR §1926.1101). Each worker will be fitted with two personal sampling pumps. The first pump will be used to collect two consecutive samples that represent the entire demolition activity; the second pump will be used to collect a single sample that represents the demolition activity. The samplers will run the entire time the individual is performing the specific assigned task. For example, the samplers for the truck drivers will operate from the time they come on site until they leave the site (or the landfill) for the day. The sampling will remain operating during transit between the demolition site and the landfill. Personal samples for Lead (29 CFR §1926.62) will be collected over the entire demolition and debris handling period. The estimated number of air samples to be collected and analyzed for asbestos, total fibers, and lead is presented in Table B-3.

Table B-3. Worker Exposure Monitoring Samples for Asbestos and Lead During Building Demolition and Debris Loading

Worker	Number of Samples						Total Samples
	NESHAP Method			Alternative Method			
Asbestos[a]							
	Period 1	**Period 2**	**Periods 1 + 2**	**Period 1**	**Period 2**	**Periods 1 + 2**	
Excavator Operator	1	1	1	1	1	1	6
Hose Operators (2)	2	2	2	2	2	2	12
Truck Operators (3)	3	3	3	3	3	3	18
Open Field Blank	1			1			2
Closed Field Blank[b]	1			1			2
Total Samples	**14**		**6**	**14**		**6**	**40**
Lead							
	Periods 1 + 2			**Periods 1 + 2**			
Excavator Operator	1			1			2
Hose Operators (2)	2			2			4
Truck Operators (3)	3			3			6
Open Field Blank	1			1			2
Total Samples	**7**			**7**			**14**

[a] Samples will be analyzed both for asbestos (ISO 10312:1995) and total fibers (NIOSH 7400, A Rules).
[b] Closed field blanks will only be analyzed if asbestos contamination is detected on the open field blanks.

B1.2.2.1 Worker Activity Exposure Monitoring

Personal breathing zone monitoring for asbestos will be conducted on workers during operation of the perimeter air monitors in Ring 1. The sampling will be conducted during the entire demolition activity. The estimated number of air samples to be collected and analyzed for asbestos and total fibers is presented in Table B-4.

Table B-4. Worker Activity Exposure Monitoring Samples for Asbestos During Building Demolition

Worker	Number of Samples						Total Samples
	NESHAP Method			Alternative Method			
Asbestos[a]							
	Period 1	Period 2	Periods 1 + 2	Period 1	Period 2	Periods 1 + 2	
Walkers (3)	3	3	3	3	3	3	18
Open Field Blank	1			1			2
Closed Field Blank[b]	1			1			2
Total Samples	**8**		**3**	**8**		**3**	**22**

[a] Samples will be analyzed both for asbestos (ISO 10312:1995) and total fibers (NIOSH 7400, A Counting Rules).
[b] Closed field blanks will only be analyzed if asbestos contamination is detected on the open field blanks.

B1.2.3 Soil Sampling

Soil samples will be collected prior to demolition of each building. Following demolition, all demolition debris will be removed from each building site and soil samples will then be collected. In the case of the Alternative Method Building, the top 2-3 inches of soil will then be excavated and removed from the site and an additional set of soil samples will be collected. The comparison of asbestos soil concentrations between the two methods will be based upon the post-demolition values for the NESHAP Method vs. the post-excavation values for the Alternative Method.

For each of the soil sampling events described above, the containment-berm area will be evenly divided into a 10-block grid system. Ten interleaved composite samples will be collected from the bermed area. Each sample will be a composite of 30 grab samples, three from a random location in each of the 10 blocks of the grid. The sampling grid for the NESHAP Method Building and Alternative Control Method Building is shown in Figure B-12. The estimated number of soil samples to be collected and analyzed for asbestos is presented in Table B-5.

Table B-5. Soil Samples for Asbestos Analysis

Phase	Type of Sample	Number of Samples		Total Samples
		NESHAP Method	Alternative Method	
Pre-Demolition	Soil	10	10	20
	Total Samples	10	10	20
Post-Demolition	Soil	10	10	20
	Total Samples	10	10	20
Post-Excavation	Soil	0	10	10
	Total Samples	0	10	10
TOTAL SAMPLES				**50**

B1.2.4 Asbestos from Soil Elutriation Method

Thirty percent of the soil samples collected in Section B1.2.3 will be submitted for analysis using an elutriation method. This will provide a measure of the asbestos concentration in respirable dust in the soils. The number of soil samples that will be analyzed is presented in Table B-6.

Table B-6. Soil Elutriation Samples for Asbestos Analysis

Phase	Type of Sample	Number of Samples		Total Samples
		NESHAP Method	Alternative Method	
Pre-Demolition	Soil	3	3	6
Post-Demolition	Soil	3	3	6
Post-Excavation	Soil	0	3	3
TOTAL SAMPLES				**15**

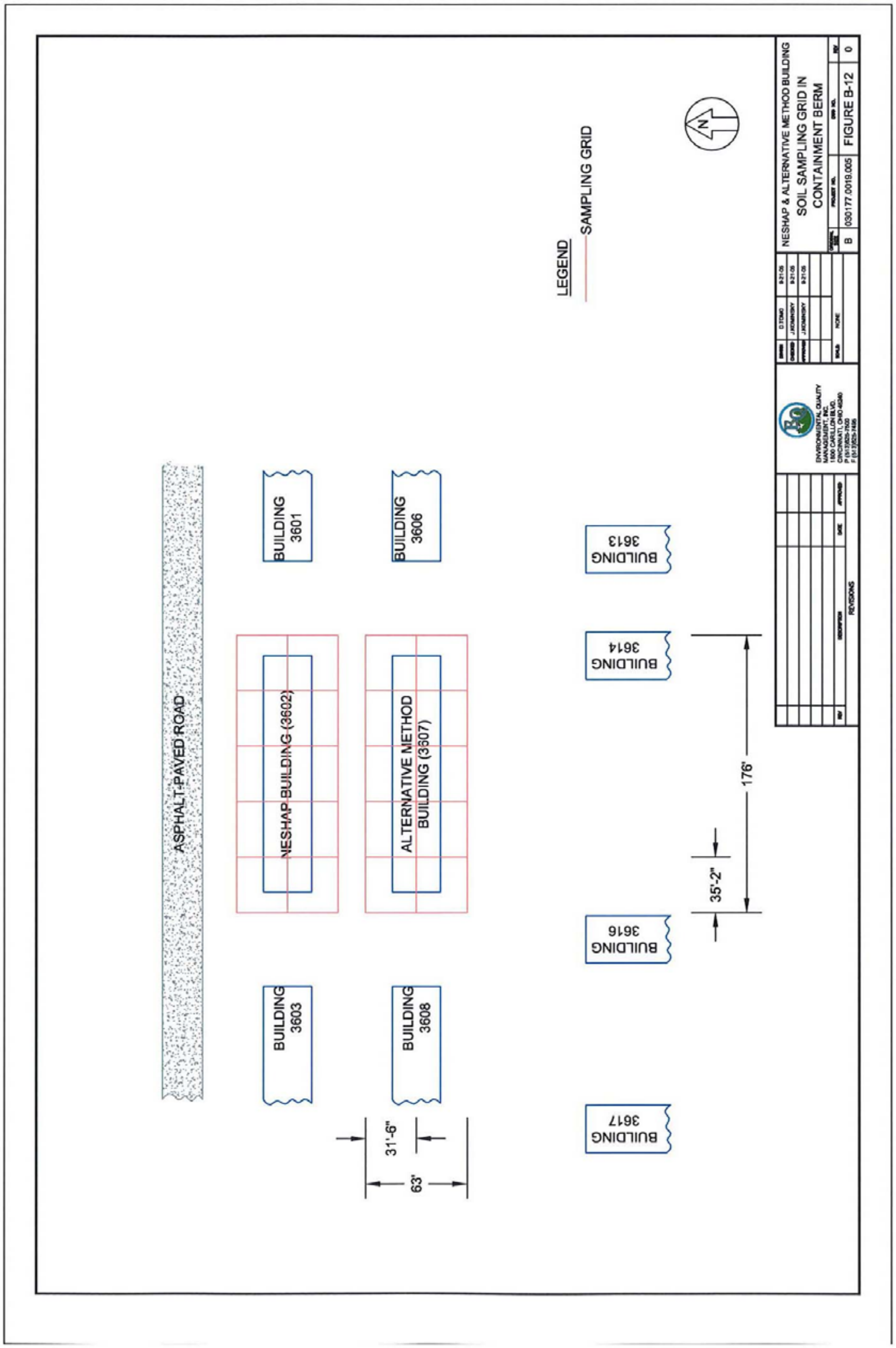

Figure B-12. Soil Sampling Grid within Containment Berms of the NESHAP and Alternative Method Buildings

B1.2.5 Settled Dust From Demolition

If any asbestos-containing dust is released during the demolition of the buildings and associated debris-loading activities, it could settle on nearby surfaces. Settled dust collectors will be placed at the same locations as the perimeter samples in Rings 1, 2, and 3. The dust collectors will be placed five feet above ground at 40-degree intervals in each of the three concentric rings. The estimated number of settled dust samples for asbestos analysis is presented Table B-7.

B1.2.6 Surface Water From Demolition

As described in Section A6.1.2, containment berms will be used to trap water runoff during demolition and debris loading of the NESHAP Method and Alternative Control Buildings. Representative samples of surface water will be collected during the duration of the demolition activity for both the NESHAP and Alternative Method Buildings. Drainage channels will be constructed to direct water runoff for collection in metal-fabricated basins located within the containment berm. These channels will be small in size, constructed of impervious material, and are only intended to assure some collection of runoff, not to divert flow. This is intended to have minimal impact on soil permeation. The sampling of the collected runoff water will be spaced over the duration of the demolition activity. Sample collection volumes will be noted as a function of time and as a function of the progression of the demolition. The estimated number of surface water samples that will be collected for asbestos analysis is presented in Table B-8.

B1.2.7 Source Water for Wetting Structure and Demolition Debris

The asbestos concentration of the source water applied to control the particulate emissions during demolition and debris loading of the NESHAP Method and Alternative Method Buildings will be measured. A source sample will be collected at both the commencement and completion of the demolition activities. A sample of amended water will be collected in the morning and in the afternoon. The estimated number of source water samples for asbestos analysis is presented in Table B-9. *Note:* The applicable field blank for these samples is included in Table B-8.

Table B-7. Settled Dust Samples at Perimeter Rings for Asbestos Analysis During Demolition and Debris Loading

Ring	Sample Type	Number of Samples		Total Samples
		NESHAP Method	Alternative Method	
R1@ 5-ft	Settled Dust	9	9	18
	Duplicate	1	1	2
	Field Blank	1	1	2
	Total Samples	11	11	22
R2@ 5-ft	Settled Dust	9	9	18
	Duplicate	1	1	2
	Field Blank	1	1	2
	Total Samples	11	11	22
R3@ 5-ft	Settled Dust	9	9	18
	Duplicate	1	1	2
	Field Blank	1	1	2
	Total Samples	11	11	22
TOTAL SAMPLES				**66**

Table B-8. Surface Water Samples for Asbestos Analysis During Demolition and Debris Loading

Sample Type	Number of Samples		Total Samples
	NESHAP Method	Alternative Method	
Water	4	4	8
Duplicate	1	1	2
Field Blank	1	1	2
Total Samples	6	6	**12**

Table B-9. Source Water Samples for Asbestos Analysis

Sample Type	Number of Samples		Total Samples
	NESHAP Method	Alternative Method	
Water (Before Demolition)	1	1	2
Water (After Demolition)	1	1	2
Amended Water	0	2	2
Total Samples	2	4	**6**

B1.3 Monitioring During Landfilling of Demolition Debris

B1.3.1 Perimeter Air Monitoring During Landfilling of Demolition Debris

Stationary air monitors will be positioned to measure the concentration of airborne asbestos fibers during landfilling of the demolition debris from the NESHAP Method and Alternative Method Buildings. The perimeter air monitoring network will consist of one ring of monitors. The goal will be to place the monitors at 40-degree intervals measured along a radius from the center of the asbestos landfilling activity as site conditions permit, i.e., topography and other landfilling activities. The monitors will be placed at a height of 5 feet above ground and approximately 15 feet from the activity, or as close to that as possible.

The estimated number of air samples to be collected and analyzed for asbestos is summarized in Table B-10. Air sampling will be conducted for two sequential periods per workday as described for the perimeter air samples at the demolition site; see Section B1.2.1. It is assumed that the landfilling of the demolition debris for each building will occur over one day. All samples will have a target air volume of 1,920 to 2,400 liters.

Table B-10. Perimeter Air Monitoring Samples for Asbestos Analysis[a] During Landfilling of Demolition Debris

Ring	Sample Type	Number of Samples				Total Samples
		NESHAP Method		Alternative Method		
		Period 1	Period 2	Period 1	Period 2	
R1@ 5-ft	Sequential 4-5 hr period	9	9	9	9	36
	Duplicates	1	1	1	1	4
	Open field blank	1		1		2
	Closed field blank[b]	1		1		2
	Total Samples	12	10	12	10	44

[a] Samples will be analyzed both for asbestos (ISO 10312:1995) and total fibers (NIOSH 7400, A Counting Rules).
[b] Closed field blanks will only be analyzed if asbestos contamination is detected on the open field blanks.

B1.3.2 Air Monitoring of Workers during Landfilling

Personal breathing zone samples will be collected from the bulldozer operator involved with the landfilling of the demolition debris. Personal samples for asbestos and total fibers will be collected during the two sampling periods (morning and afternoon) to calculate the time-weighted average concentration for comparison to the OSHA Permissible Exposure Limit for Asbestos (29 CFR §1926.1101). The worker will be fitted with two personal sampling pumps.

The first pump will be used to collect two consecutive samples that represent the entire demolition activity; the second pump will be used to collect a single sample that represents the demolition activity. In addition, a fixed-station area sample will be positioned in the cab of the same bulldozer for asbestos and total fibers analysis. Personal samples for Lead (29 CFR §1926.62) will be collected over the entire day of the landfilling activity. The estimated number of air samples to be collected and analyzed for asbestos and total fibers, and lead is presented in Table B-11.

Table B-11. Worker Exposure Monitoring Samples for Asbestos and Lead During Landfilling of Building Demolition Debris

Worker	Number of Samples						Total Samples
	NESHAP Building			Alternative Method Building			
Asbestos[a]							
	Period 1	**Period 2**	**Periods 1 + 2**	**Period 1**	**Period 2**	**Periods 1 + 2**	
Bulldozer Operator	1	1	1	1	1	1	6
Cab of Bulldozer	1	1	1	1	1	1	6
Open Field Blank	1			1			2
Closed Field Blank[b]	1			1			2
Total Samples	**8**			**8**			**16**
Lead							
	Periods 1 + 2			**Periods 1 + 2**			
Bulldozer Operator	1			1			2
Cab of Bulldozer	1			1			2
Open Field Blank	1			1			2
Total Samples	**3**			**3**			**6**

[a] Samples will be analyzed both for asbestos (ISO 10312:1995) and total fibers (NIOSH 7400, A Counting Rules).
[b] Closed field blanks will only be analyzed if asbestos contamination is detected on the open field blanks.

B1.4 Background Air Monitoring

B1.4.1 Background Air Monitoring at Demolition Site

Air monitoring will be conducted prior to asbestos abatement of the NESHAP Building and prior to demolition of the Alternative Method Building to collect data necessary for potential comparison of air concentrations of asbestos and total fibers during demolition. The monitoring will be conducted prior to the asbestos abatement of the NESHAP Method Building and prior to demolition of the Alternative Method Building. Monitoring will be conducted approximately between 08:00 to 12:00 hours and 12:00 to 16:00 hours. The target air volume for a 4 hour sample at a flow rate of 8 lpm is 1,920 liters. If the wind speed exceeds 15 mph (average) or 20 mph (gusts), sampling will cease until satisfactory conditions resume.

The air monitoring network will consist of one ring of monitors around the building. The monitors will be placed at 60-degree intervals measured along a radius from the center of the building. The monitors will be placed within 15 feet of the building and at a height of 5 feet above ground. The estimated number of air samples to be collected and analyzed for asbestos is presented in Table B-12.

Table B-12. Background Air Monitoring Samples for Asbestos Analysis[a] Around the NESHAP Method and Alternative Control Buildings

Phase	Type of Sample	Number of Samples		Total Samples
		NESHAP Method (Prior to Asbestos Removal)	Alternative Method (Prior to Demolition)	
(08:00-12:00)	Air	6	6	12
	Duplicate	1	1	2
	Open Blank	1	1	2
	Closed Blank[b]	1	1	2
	Total Samples	9	9	18
(12:00-16:00)	Air	6	6	12
	Duplicate	1	1	2
	Total Samples	7	7	14
Total Samples				**32**

[a] Samples will be analyzed both for asbestos (ISO 10312:1995) and total fibers (NIOSH 7400, A Counting Rules).
[b] Closed field blanks will only be analyzed if asbestos contamination is detected on the open field blanks.

B1.4.2 Background Air Monitoring at Landfill

Air monitoring will be conducted prior to disposal of any materials from the NESHAP Method and Alternative Method Buildings to collect data necessary for potential comparison of air concentrations of asbestos and total fibers during disposal. The monitoring will be conducted prior to disposal of the respective waste streams. Monitoring will be conducted between 08:00 to 12:00 hours and between12:00 to 16:00 hours.

The air monitoring network will consist of one ring of monitors. The monitors will be placed at 60-degree intervals measured along a radius from the center of the debris landfilling area. The monitors will be placed as close to the area as feasible (the goal is 15 feet from the activity) and at a height of 5 feet above ground. The estimated number of air samples to be collected and analyzed for asbestos is presented in Table B-13.

Table B-13. Background Air Monitoring Samples for Asbestos Analysis[a] At the Landfill Prior to Disposal of Materials from the NESHAP Method and Alternative Method Buildings

Phase	Type of Sample	Number of Samples			Total Samples
		NESHAP Method		Alternative Method	
		Abatement	Demolition		
(08:00-12:00)	Air	6	6	6	18
	Duplicate	1	1	1	3
	Open Blank	1	1	1	3
	Closed Blank[b]	1	1	1	3
	Total Samples	9	9	9	27
(12:00-16:00)	Air	6	6	6	18
	Duplicate	1	1	1	3
	Total Samples	7	7	7	21
Total Samples					**48**

[a] Samples will be analyzed both for asbestos (ISO 10312:1995) and total fibers (NIOSH 7400, A Counting Rules).
[b] Closed field blanks will only be analyzed if asbestos contamination is detected on the open field blanks.

B1.5 Air Monitoring During Asbestos Abatement of NESHAP Method Building

B1.5.1 Discharge Air from HEPA-Filtration Units

In-duct monitoring of the discharge air from each HEPA-filtration unit used during the abatement of the NESHAP Method Building will be conducted. It is assumed that four air filtration units will be used. The estimated number of air samples to be collected and analyzed for asbestos and total fibers is presented in Table B-14.

Table B-14. Air Monitoring Samples for Asbestos[(a)] Analysis of Discharge Air From HEPA-Filtration Units

Sample Type	Number of Samples
Air	4
Duplicate	1
Open Field Blank	1
Closed Field Blank[b]	1
Total Samples	7

[a] Samples will be analyzed both for asbestos (ISO 10312:1995) and total fibers (NIOSH 7400, A Counting Rules).
[b] Closed field blanks will only be analyzed if asbestos contamination is detected on the open field blanks.

B1.5.2 Air Monitoring During Loading of Bagged ACM

The air around the disposal container (e.g., truck or roll-off container) will be monitored to determine whether this activity releases airborne asbestos fibers that are above comparative background. The monitors will be placed at 60-degree intervals measured along a radius from the center of the disposal container. The monitors will be placed within 10 feet of the disposal container and at heights of 5 feet and 15 feet above ground. The estimated number of air samples to be collected and analyzed for asbestos and total fibers is presented in Table B-15.

Table B-15. Air Monitoring Samples for Asbestos Analysis[a] During Loading of Bagged ACM from NESHAP Method Building

Sample Height	Sample Type	Number of Samples
5-feet	Air	6
15-feet		6
Duplicate		1
Open Field Blank		1
Closed Field Blank[b]		1
Total Samples		15

[a] Samples will be analyzed both for asbestos (ISO 10312:1995) and total fibers (NIOSH 7400, A Counting Rules).
[b] Closed field blanks will only be analyzed if asbestos contamination is detected on the open field blanks.

B1.5.3 Air Monitoring During Landfilling of NESHAP Method Bagged ACM

The air during landfilling of the bagged asbestos-containing materials from abatement of the NESHAP Method Building will be monitored to determine whether this activity releases airborne asbestos fibers that are above comparative background. The activity is expected to take less than four hours. The monitors will be placed at 60-degree intervals measured along a radius from the center of the landfilling activity and at a height of 5 feet above ground. In addition, the bulldozer operator will be fitted with a personal sampling pump which will operate over the entire period of the activity. In addition, a fixed-station area sample will be positioned in the cab of the same bulldozer for asbestos and total fibers analysis. The estimated number of air samples to be collected and analyzed for asbestos and total fibers is presented in Table B-16.

**Table B-16. Air Samples for Asbestos[a]
During Landfilling of Bagged Asbestos-Containing Waste
from Abatement of NESHAP Building**

Type of Sample	Number of Samples
Perimeter	6
Bulldozer Operator	1
Bulldozer Operator Cab	1
Open Field Blank	1
Closed Field Blank[b]	1
Total Samples	**10**

[a] Samples will be analyzed both for asbestos (ISO 10312:1995) and total fibers (NIOSH 7400, A Counting Rules).
[b] Closed field blanks will only be analyzed if asbestos contamination is detected on the open field blanks.

B1.6 Summary of Field Samples

The number of field samples that will be collected for asbestos analysis by TEM is summarized in Table B-17.

B-17. Summary of Field Samples to be Collected for Asbestos Analysis by TEM

Source Table	Air[a]	Soil	Water	Settled Dust	QC	Total Samples
B-2: Perimeter air demolition site	288	-	-	-	48	336
B-3: Worker during building demolition	36	-	-	-	4	40
B-5: Bulk soil	-	50[b]	-	-	-	50
B4: Worker activity during demolition	18	-	-	-	4	22
B-6: Soil elutriation	15	-	-	-	-	15
B-7: Perimeter settled dust	-	-	-	54	12	66
B-8: Surface run-off water	-	-	8	-	4	12
B-9: Source water (hydrant and amended)	-	-	6	-	-	6
B-10: Perimeter air landfilling	36	-	-	-	8	44
B-11: Worker during landfilling	12	-	-	-	4	16
B-12: Background at demolition site	24	-	-	-	8	32
B-13: Background at landfill	36	-	-	-	12	48
B-14: HEPA discharge	4	-	-	-	3	7
B-15: Loading bagged ACM at demo site	12	-	-	-	3	15
B-16: Landfill bagged ACM	8	-	-	-	2	10
Total samples	**489**	**50**	**14**	**54**	**112**	**719**

[a] Samples (excluding soil elutriation and HEPA discharge samples) will also be analyzed for total fibers (NIOSH 7400, A Counting Rules).
[b] Soils samples will be analyzed by both PLM and TEM.

B2 SAMPLING METHOD REQUIREMENTS

B2.1 Air Sampling

B2.1.1 Perimeter Air Sampling for Asbestos

The samples for both asbestos and total fibers analysis will be collected on the same open-face, 25-mm-diameter 0.45-µm pore size mixed cellulose ester (MCE) filters with a 5-µm pore size MCE diffusing filter and cellulose support pad contained in a three-piece cassette with a 50-mm non-conductive cowl. This design of cassette has a longer cowl than the design specified in ISO 10312:1995, but it has been in general use for some years for ambient and indoor air sampling. Disposable filter cassettes with shorter conductive cowls, loaded with the appropriate combination of filter media of known and consistent origin, do not appear to be generally available.

The filter cassettes will be positioned on a sampling pole that will accommodate cassette placement at 5 feet and 15 feet above ground. The filter face will be positioned at approximately a 45-degree angle toward the ground. At the end of the sampling period, the filters will be turned upright before being disconnected from the vacuum pump and then stored in this position.

The filter assembly will be attached with flexible Tygon® tubing (or an equivalent material) to an electric-powered [110 volts alternating current (VAC)] 1/10-horsepower vacuum pump operating at an airflow rate of approximately 8 liters per minute. An air volume of 1,920 to 2,400 liters will be achieved for all samples. Each pump will be equipped with a flow-control regulator to maintain the initial flow rate of 8 liters per minute to within +/- 10% throughout the sampling period. If a 110-VAC line power is not available (such as at the landfill), portable 15-20 amp gasoline-powered generators will be used to power the sampling pumps.

B2.1.2 Worker Exposure Monitoring for Asbestos and Lead

Asbestos—Personal breathing samples will be collected on open-face, 25-mm-diameter 0.8-µm pore size MCE filters with a cellulose support pad contained in a three-piece cassette with a 50-mm non-conductive cowl. The filter assembly will be attached to a constant-flow, battery-powered vacuum pump operating at a flow rate of 2 liters per minute. An air volume of 480 to 600 liters will be achieved for all samples.

Lead—Personal breathing samples will be collected on closed-face, 37-mm diameter 0.8-μm pore size MCE filters with a cellulose support pad contained in a three-piece cassette. The filter assembly will be attached to a constant-flow, battery-powered vacuum pump operating at a flow rate of 2 liters per minute. An air volume of 480 to 600 liters will be achieved for all samples.

B.2.2 Real-Time Aerosol Monitoring

Real-time measurement and recording of aerosol (dust) concentrations in air at the demolition site and landfill will be made using a particle measuring device (MEI personal DataRam Model pDR 1200). It is intended to be used as a semi-quantitative (relative) index of the concentration of airborne dust particles in the vicinity of workers engaged in the demolition and landfilling activities. The instrument is designed to measure particles in the 0.1 μm to 10 μm range with a concentration measurement range of 0.1 to 400 mg/m^3.

B2.3 Meteorological Monitoring

Two portable meteorological stations manufactured by Met One Instruments, Inc., and equipped with AutoMet Sensors (or equivalent instruments) will be used to record 5-minute average wind speed and wind direction data, as well as temperature, barometric pressure, and relative humidity. A meteorological station will be installed at both the Fort Chaffee demolition site and the City of Fort Smith Landfill. The data files will be downloaded and archived by using an on-site personal computer. Periodic (at least hourly) direct readout of the data will be recorded on a Meteorological Measurement Log (Figure A-12).

B2.4 Soil Sampling

Ten interleaved composite samples will be collected from the within the bermed area. Each sample will be a composite of 30 grab samples, three from random locations in each of the 10 blocks of the grid. A second composite sample will be collected over the same study area following this procedure with different locations sampled within the subsections. This will be repeated until 10 composite samples are collected. Each sample will be collected from an area measuring 6-inches by 6-inches with approximately a ½-inch depth. The area will be delineated by using a template. The use of a template will help ensure that each component of the 10-part composite sample is of similar mass.

The soil samples will be collected by using a clean metal scooping tool (e.g., a garden trowel) and placed in a cleaned plastic container with screw cap. Between collections of each sample, the template and trowel will be cleaned with detergent water.

The ten composite soil samples will be sent to RTI. RTI will dry, homogenize, and evenly split the samples into two fractions. One fraction will be sent to REI for total asbestos analysis (PLM and TEM) and one-third of the other fraction, chosen at random, will be sent to Lab/Cor for soil elutriation tests. The remaining two-thirds will be archived by RTI.

B2.4.1 Preparation of Soil Samples for Asbestos Analysis

RTI International will receive and process the samples as follows:

1. Receive and log sample.

2. The modified elutriator method requires the sample be dried at a temperature not exceeding 60 °C. The samples can best be blended and subdivided if they are dried. Therefore, the samples will be dried at a temperature of 60 °C for 24 hours to comply with these requirements and to facilitate the mixing and sample apportionment. If the sample is not dry after the 24 hour period, the samples will be dried for additional 24 hour periods until dryness is achieved.

3. The dried samples will be subjected to mixing for homogenization and cone-and-quarter for splitting the samples into two separate portions as described in EPA 540-R-97-028. Each dried sample will be homogenized by tumbling in a tightly sealed metal container. Sample material will be introduced into the container such that the container does not exceed half-full. As the container is filled, any readily visible soil clods or soft aggregates will be reduced by hand to facilitate mixing. No attempt will be made to reduce the size of any building debris in the sample. The container will be closed and sealed, and will then be rotated, at a rate of approximately 50 RPMs, through 100 revolutions. After waiting 15 minutes to allow any “fines” to settle, the container will be opened and the contents assessed for their suitability to be coned and quartered. If deemed suitable, the contents will be emptied onto a large clean surface for holding, and the aforementioned process will be repeated for the balance of the sample. Each homogenized sample portion will be emptied onto the previously accumulated sample cone until all the sample portions have been homogenized and combined into one cone. The large cone will then be halved by pushing the plate vertically downward into the cone at the cone apex. Each sample half will then be placed in a separate container.

If after 100 revolutions, a sample is deemed to be insufficiently homogenized, the process will be repeated in increments of 100 additional revolutions until sufficient homogenization has been achieved.

4. The subsamples will be labeled with the sample identification numbering system as provided with the samples.

5. All devices used for preparing the samples will be thoroughly cleaned before and between each sample preparation.

B2.5 Settled Dust Sampling

Settled dust samples for asbestos and lead analysis will be passively collected by using ASTM Method D 1739-98 *"Method for Collection and Measurement of Dustfall (Settleable Particulate Matter."* The collection container is an open-topped cylinder approximately 6 inches in diameter with a height of 12 inches. The container will be fastened to the same sampling pole as the air samples at a height of 6 feet above the ground. The sampling time for the ASTM protocol will be extended one hour beyond the end of demolition activity. Upon completion of sampling the dust collection container will capped and sealed for shipment to the laboratory.

B2.6 Source Water Sampling—Hydrant and Amended Water

The sample container will be an unused, 1-liter pre-cleaned, screw-capped glass bottle. Prior to sample collection, the water from the water source must be allowed to run for a sufficient period to ensure that the sample collected is representative of the source water.

Approximately 800 milliliters of source water for each sample will be collected. An air space will be left in the bottle to allow efficient re-dispersal of settled material before analysis. A second bottle will be collected and stored for analysis if confirmation of the results obtained from the analysis of the first bottle is required.

The samples will be transported to the analytical laboratory and filtered by the laboratory within 48 hours of each sample collection. No preservatives or acids will be added. At all times after collection, the samples will be stored in the dark and stored at about 5° C (41° F) in order to minimize bacterial and algal growth. The samples will not be allowed to freeze because the effects on asbestos fiber dispersions are not known. On the same day of collection the samples will be shipped in a cooler at about 5° C (41° F) to the lab for analysis via one-day courier service.

B2.7 Water Sampling—Contained Runoff Water

The sample container will be an unused, 1-liter pre-cleaned, screw-capped glass bottle. Samples will be collected by scooping runoff water from the collection basin. Approximately 800 mL of source water will be collected. An air space will be left in the bottle to allow efficient redispersal of settled material before analysis. A second bottle will be collected and stored for analysis if confirmation of the results obtained from the analysis of the first bottle is required.

The samples will be transported to the analytical laboratory and filtered by the laboratory within 48 hours of each sample collection. No preservatives or acids will be added. At all times after collection, the samples will be stored in the dark and stored at about 5° C (41° F) in order to minimize bacterial and algal growth. The samples will not be allowed to freeze because the effects on asbestos fiber dispersions are not known. On the same day of collection the samples will be shipped in a cooler at about 5° C (41° F) to the laboratory for analysis via one-day courier service.

B2.8 Soil Elutriation Tests

Once in the laboratory, the soil samples will be prepared and analyzed as described in the Modified Elutriator Method (Berman and Kolk 2000). Briefly, the method involves placing an approximately 60 g (weighed) sample in a tumbler (one-inch square cross section), passing constant humidity air over the sample while tumbling (to pick up entrainable dust), separating out the respirable fraction[8] of dust in a vertical elutriator, and depositing the resulting dust on a pre-weighed polycarbonate filter, which is re-weighed (to determine the quantity of dust deposited) and prepared (using a direct transfer procedure) for analysis by TEM (ISO 10312-1995) for the determination of asbestos. Results are reported as the number of asbestos structures per microgram of respirable dust (as/μg_{PM10}).

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8 The respirable fraction is composed of respirable dust. Respirable dust is defined as the set of structures exhibiting an aerodynamic equivalent diameter (AED) less than or equal to 10 µm, which is captured by devices designed to extract what is termed the "PM_{10}" fraction of particulate matter. The AED of a particle is the diameter of a sphere of unit density that exhibits the same settling velocity in air as that of the actual particle.

B3 SAMPLE CUSTODY REQUIREMENTS

EQ's chain-of-custody procedures emphasize careful documentation of constant secure custody of samples during the field, transport, and analytical stages of environmental measurement projects. The sample custodian (and alternate) responsible for the proper chain-of-custody during this project is:

John R. Kominsky (and alternate Bruce A. Hollett)
Environmental Quality Management, Inc.
1800 Carillon Boulevard, Cincinnati, OH 45240
Phone: 513.825.7500; fax: 513.825.7495

B3.1 Field Chain-of-Custody

Each sample will have a unique project identification number. A unique sample identification system will be developed for the samples collected at the demolition site and the samples collected at the landfill. The numbering system will also be unique for each building: i.e., #3602 and #3607. QC samples will be blind to the laboratory. This identification number will be recorded on a Sampling Data Form (Figures A-8 through A-12) along with the other information specified on the form. After the labeled sample cassettes and containers are inspected, the sample custodian will complete an Analysis Request and Chain-of-Custody Record (Figure B-13). This form will accompany the samples, and each person having custody of the samples will note receipt of the same and complete an appropriate section of the form. Samples will be sent to the appropriate Laboratory (see Section A8.2) via Federal Express Overnight Service.

B3.2 Analytical Laboratory

The laboratory's sample clerk will examine the shipping container and each sample cassette or sample container to verify sample numbers and check for any evidence of damage or tampering. The chain of custody form is checked for completeness and signed and dated to document receipt. Any changes will be recorded on the original chain-of-custody form and then the form will be forwarded to the EQ Project Manager. The sample clerk will log in all samples and assign a unique laboratory sample identification number to each sample and sample set. Chain-of-custody procedures will be maintained in the analytical laboratory.

EQ **Environmental Quality Management, Inc.**

ANALYSIS REQUEST AND CHAIN OF CUSTODY RECORD

Reference Document No. A- 0305
Page 1 of _____

Project Name ____________________
Project Number ____________________
Project Manager ____________________
Sample Team Leader ____________________

Lab Destination ____________________
Lab Contact/Phone ____________________
Lab Purchase Order No. ____________________
Carrier/Waybill No. ____________________

Report to: ____________________
____
____
____
Bill to: ____________________
____
____
____

ONE CONTAINER PER LINE

Sample Number	Sample Description/Type	Date/Time Collected	Container Type	Sample Volume	Pre-servative	Requested Analytical Method/(Parameters)	Condition on Receipt (Lab)

Special Instructions:

Possible Hazard Identification:
Non-hazard ☐ Flammable ☐ Skin Irritant ☐ Other ____________

Sample Disposal:
Return to Client ☐ Disposal by Lab ☐ Archive _______(mos.)

Turnaround Time Required:
Normal ☐ Rush ☐ Results Required by ____________

QA Requirements:

1. Relinquished by (Signature/Affiliation) Date: ____________ Time:

1. Received by (Signature/Affiliation) Date: ____________ Time:

2. Relinquished by (Signature/Affiliation) Date: ____________ Time:

2. Received by (Signature/Affiliation) Date: ____________ Time:

Comments:

Figure B-13. Analytical Request and Chain-of-Custody Form

B4 ANALYTICAL METHOD REQUIREMENTS

B4.1 Air Samples (TEM)

Perimeter Samples—The 0.45-µm pore size mixed-cellulose ester (MCE) air sampling filters will be prepared and analyzed by using ISO Method 10312:1995, *Ambient Air - Determination of Asbestos Fibres - Direct-Transfer Transmission Electron Microscopy Method.*" Note: After TEM analysis, a sector from the same filter will then be analyzed using PCM (see Section B4.2 "*Air Samples (PCM)*"). If the samples are overloaded, they will be analyzed by ISO 13794:1999, *Ambient Air-Determination of Asbestos Fibers: Indirect-Transfer Transmission Electron Microscopy Method (TEM).*

Personal Samples— The 0.8-µm pore size mixed-cellulose ester (MCE) air sampling filters will be prepared and analyzed by using ISO Method 10312:1995, *Ambient Air - Determination of Asbestos Fibres - Direct-Transfer Transmission Electron Microscopy Method.*" Note: After TEM analysis, a sector from the same filter will then be analyzed using PCM (see Section B4.2 "*Air Samples (PCM)*"). If the samples are overloaded, they will be analyzed by ISO 13794:1999, *Ambient Air-Determination of Asbestos Fibers: Indirect-Transfer Transmission Electron Microscopy Method (TEM).*

B4.1.1 TEM Specimen Preparation

TEM specimens will be prepared from the air filters by using the dimethylformamide (DMF) collapsing procedure of ISO 10312:1995, as specified for cellulose ester filters. DMF will be used as the solvent for dissolution of the filter in the Jaffe washer. For each filter, a minimum of two TEM specimen grids will be prepared from a one-quarter sector of the filter by using 200 mesh-indexed copper grids. The remaining part of the filter will be archived, in the original cassette in clean and secure storage, to be possibly selected for quality assurance analyses.

B4.1.2 Measurement Strategy

1. The minimum aspect ratio for the analyses shall be 3:1, as permitted by ISO 10312:1995.

2. Table B-18 presents the size ranges of structures that will be evaluated, and target analytical sensitivities for each TEM method. The laboratories will adjust individual numbers of grid openings counted based upon the counting rules and the amount of material prepared for each sample.

3. A minimum of ten grid openings shall be examined. If ten or more structures are identified, counting is stopped. If less than ten structures are identified, counting is continued until ten structures are identified or the required area is examined which corresponds to the desired analytical sensitivity.

4. The structure counting data shall be distributed approximately equally among a minimum of two specimen grids prepared from different parts of the filter sector.

5. The TEM specimen examinations will be performed at approximately 20,000 magnification.

6. PCM-equivalent asbestos fibers will also be determined for the air samples.

7. The type of fiber will be specified. In addition to classifying fibers as one of the six NESHAP-regulated asbestos varieties, all other amphibole mineral particles meeting the aspect ration of ≥3:1 and lengths >5 µm) will be recorded. This includes non-NESHAP-regulated asbestos amphiboles (e.g., winchite, richterite). Reference to or implication of either use of the term cleavage fragments and/or discriminatory counting shall not apply.

B4.1.3 Determination of Stopping Point

The analytical sensitivity and detection limit of microscopic methods (such as TEM and PCM) are a function of the volume of air drawn through the filter and the number of grid openings or fields counted. In principle, any required analytical sensitivity or detection limit can be achieved by increasing the number of grid openings or field examined. Likewise, statistical uncertainty around the number of fibers observed can be reduced by counting more and more fibers. Stopping rules are needed to identify when microscopic examination should end, both at the low end (zero or very few fibers observed) and at the high end (many fibers observed).

Table B-18. Approximate Number of TEM Grid Openings to Achieve Target Analytical Sensitivity

Method	Structure Size Range	Target Analytical Sensitivity	Approximate Magnification for Examination	Approximate Grid Area Examined, mm^2	Approximate Number of 0.01-mm^2 Grid Openings Required
ISO 10312 – Perimeter Air Direct Preparation	All Structures (minimum length of 0.5 µm; aspect ratio $\geq$3:1)	0.0005 s/cc	20,000	0.32 based on air Volume of 2,400 L	32
ISO 10312 – Worker Air Direct Preparation	All Fibers (minimum length of 0.5 µm; aspect ratio $\geq$3:1)	0.005 f/cc	10,000	0.16 based on air Volume of 480 L	16
EPA/600/R-93/116, 1993 – Soil	All Structures (minimum length of 0.5 µm; aspect ratio $\geq$3:1)	0.1%	20,000	0.1	10
ASTM D 5755-03 – Settled Dust	All Structures (minimum length of 0.5 µm; aspect ratio $\geq$3:1)	250 s/cm^2	20,000	0.1 based on filter area of 923 mm^2 and 100 ml of 500 ml filtered	10
EPA 100.2 – Water Hydrant Source and Runoff Source	All Structures (minimum length of 0.5 µm; aspect ratio $\geq$3:1)	0.05 million s/L Hydrant 2 million s/L Runoff	20,000	0.37 based on filter area of 923 mm^2 and 50 ml filtered; 0.46 based on filter area of 923 mm^2 and 1 ml filtered	37 46

The following stopping rules will be used in this project:

Method	Stopping Rules
TEM (ISO 10312:1995) – perimeter air	Count 10 grid openings or until $\geq$10 structures are counted. If < 10 structures are counted, then count the number of grid openings to achieve an analytical sensitivity of 0.0005 asbestos structures/cm^3.
TEM (ISO 10312:1995) – worker air	Count 10 grid openings or until $\geq$10 structures are counted. If < 10 structures are counted, then count the number of grid openings to achieve an analytical sensitivity of 0.005 asbestos structures/cm^3.
PCM (NIOSH 7400)	100 fields are viewed or 100 fibers are counted (but not less than 10 fields must be counted).
EPA/600/R-93/116, 1993 – Soil	Terminate fiber count at a minimum of 100 fibers or 10 grid openings (whichever occurs first), providing that an analytical sensitivity of 0.1% has been achieved. If not, continue until this analytical sensitivity has been achieved. Always complete the structure count for the last grid opening evaluated.
ASTM D 5755-03 – Settled Dust	Terminate fiber count at a minimum of 100 fibers or 10 grid openings (whichever occurs first), providing that an analytical sensitivity of 250 s/cm^2 has been achieved. If not, continue until this analytical sensitivity has been achieved. Always complete the structure count for the last grid opening evaluated.
EPA 100.2 – Water	Terminate fiber count at a minimum of 100 fibers or 10 grid openings (whichever occurs first), providing that an analytical sensitivity of 0.05 million s/L or 2 million s/L depending on water source has been achieved. If not, continue until this analytical sensitivity has been achieved. Always complete the structure count for the last grid opening evaluated.

B4.2 Air Samples (PCM)

Perimeter Samples—The 0.45-µm pore size MCE air sampling filters (described in Section B4.1) will be prepared and analyzed for total fibers by using NIOSH Method 7400 "*Asbestos Fibers by PCM*" (A Counting Rules). Fibers greater than 5 µm in length and with an aspect ratio greater than 3:1 will be counted.

Personal Samples—0.8-µm pore size MCE air sampling filters will be prepared and analyzed for total fibers by using NIOSH Method 7400 "*Asbestos Fibers by PCM*" (A Counting Rules). Fibers greater than 5 µm in length and with an aspect ratio greater than 3:1 will be counted.

B4.3 Air Samples (Lead)

The 0.8-µm pore size MCE air sampling filters will be prepared and analyzed for inorganic lead by using NIOSH Method 7300 "*Elements by ICP (Nitric/Perchloric Acid Ashing).*"

B4.4 Soil Samples (TEM)

Asbestos—Soil samples will be prepared and analyzed for asbestos by using EPA's "*Method for the Determination of Asbestos in Bulk Building Materials*" (EPA/600/R-93/116, July 1993).

B4.5 Settled Dust Samples (TEM)

The analytical sample preparation and analysis for asbestos will follow ASTM Standard D5755-03 "*Microvacuum Sampling and Indirect Analysis of Dust by Transmission Electron Microscopy for Asbestos Structure Number Surface Loading*" with the following exceptions:

- Section 8 - Sampling Procedure for Microvacuum Technique: The section is replaced with ASTM D 1739-98 sample collection procedure.

- Section 10.4.1 through 10.4.3: Rinse the sample collection container with approximately 100ml of 50/50 mixture of particle-free water and reagent alcohol using a plastic wash bottle. Pour the suspension through a 1.0 by 1.0 mm opening screen into a pre-cleaned 500 or 1000 ml specimen bottle. All visible traces of the sample contained in the collection device shall be rinsed through the screen into the specimen bottle. Repeat the washing procedure three times. Discard the screen and bring the volume of the suspension in the specimen bottle up to 500ml with particle free water only.

- Section 16.2 Recording Data Rules: ISO 10312:1995 counting rules will be followed.

B4.6 Water Samples

The asbestos content of the water samples will be determined by using EPA Method 100.2 "*Analytical Method Determination of Asbestos in Water*." All fibers greater than 0.5 µm in length and with an aspect ratio of greater than or equal to 3:1 will be counted.

B4.7 Soil Elutriation Air Samples

Air samples will be prepared as described in EPA 540-2-90-005, *Modified Elutriator Method for the Determination of Asbestos in Soils and Bulk Materials* (Revision 1). The elutriated air samples will be analyzed by TEM using ISO Method 10312:1995.

B5 QUALITY CONTROL REQUIREMENTS

The overall quality assurance objective is to provide defensible data of known quality meeting quality assurance objectives. To that end, procedures are developed and implemented for field sampling, chain-of-custody, laboratory analysis, reporting, and audits that will provide results which are scientifically valid and legally defensible in a court of law.

B5.1 Field Quality Control Checks

Quality control checks for the field sampling aspects of this project will include, but not be limited to, the following:

- Use of standardized forms (e.g., Figures A-8 through A-12, B-13) to ensure completeness, traceability, and comparability of the data and samples collected.
- Calibration of air sampling equipment including pre- and post-sample calibrations using a calibrated precision rotameter.
- Proper handling of air sampling filters and sample containers to prevent cross contamination.
- Collection of field blanks and field duplicate samples.
- Field cross-checking of data forms to ensure accuracy and completeness. Strict adherence to the sample chain of custody procedures outlined in this QAPP.

B5.1.1 Air Field QC for Asbestos and Total Fibers

Field QC air samples will include open and closed field blanks and field duplicates.

B5.1.1.1 Field Blanks

Field blank samples are used to determine if any contamination has occurred during sample handling. Opened and closed field blanks will be collected each day of sampling. Opened field blanks are filter cassettes that have been transported to the sampling site, opened for a short-time ($\leq$ 30 seconds) near an actual sampling location without any air having passed through the filter, and then sent to the laboratory. Closed field blanks are filter cassettes that have been transported to the sampling site and then sent to the laboratory without being opened.

The opened field blanks will be analyzed, and the closed field blanks will be archived. The closed field blanks will only be analyzed if the opened field blanks show contamination.

B5.1.1.2 Field Duplicates

A duplicate sample is a second sample collected concurrently at the same location as the original sample.

B5.1.2 Soil Field QC for Asbestos

Due to the collection of the interleaved composite samples, field duplicate samples are not applicable.

B5.1.3 Settled Dust Field QC

Field QC settled dust samples will include field blanks and field duplicates.

B5.1.3.1 Field Blanks

A field blank is prepared by placing a collection device in the field, removing the lid and then immediately replacing the lid.

B5.1.3.2 Field Duplicates

A duplicate sample is a second sample collected concurrently at the same location as the original sample.

B5.1.4 Water Field QC

Field QC water samples will include field blanks and field duplicates.

B5.1.4.1 Field Blanks

A field blank is a clean glass container containing approximately 800 ml of laboratory water. The container filled with water will be provided by the laboratory. The container will be opened in the field for approximately 30 seconds.

B5.1.4.2 Field Duplicate

A duplicate sample is a second sample collected concurrently at the same location as the original sample, but is collected after the original sample is collected.

B5.2 Laboratory Quality Control Checks

A summary of the analytical methods and the quality assurance/quality control (QA/QC) checks is presented in Table B-19.

B5.2.1 Air Laboratory QC

B5.2.1.1 Lot Blanks

Before air samples are collected, a minimum of 2 percent of unused filters from each filter lot of 100 filters will be analyzed to determine the mean asbestos structure count. The lot blanks will be analyzed for asbestos structures by using ISO 10312:1995. If the mean count for all types of asbestos structures is found to be more than 10 structures/mm^2 the filter lot will be rejected.

B5.2.1.2 Laboratory Blank

Laboratory blanks are unused filters (or other sampling device or container) that are prepared and analyzed in the same manner as the field samples to verify that reagents, tools, and equipment are free of the subject analyte and that contamination has not occurred during the analysis process. The laboratory will analyze at least one blank for every 10 samples or one blank per prep series. Blanks are prepared and analyzed along with the other samples. If the blank control criteria (Section B.5.2.1.1) are not met, the results for the samples prepared with the contaminated blank are suspect and should not be reported (or reported and flagged accordingly). The preparation and analyses of samples should be stopped until the source of contamination is found and eliminated. Before sample analysis is resumed, contamination-free conditions shall be demonstrated by preparing and analyzing laboratory clean area blanks (see Section B5.2.2.3) that meet the blank control criteria. Laboratory blank count sheets should be maintained in the project folder along with the sample results.

Table B-19. Analytical Methods and Quality Assurance (QA)/Quality Control (QC) Checks

Matrix	Analyte	Method and Analytical Sensitivity	QA/QC Checks	Frequency	Acceptance Criteria	Corrective Action if Acceptance Criteria Not Met
Perimeter Air	Asbestos by TEM	ISO Method 10312:1995; 0.0005 s/cm^3	Lot Blanks	2% of unused filters	<10 asbestos s/mm^2	Reject filter lot
			Laboratory Blanks	Each sample batch	<10 asbestos s/mm^2	Collect and analyze clean area blanks; re-prep filter samples
			Laboratory Clean Area Blanks	Whenever laboratory blanks do not meet criteria	<10 asbestos s/mm^2	Find and eliminate source of contamination
			Replicate Analysis (recount by same analyst)	3% of samples	Acceptable Analytical Variability from Table B-20	Re-examine grids to determine cause of variation
			Verification Counting (intralab and interlab)	1% of samples	>80% true positives, <20% false negatives, <20% false positives	Re-examine grids to determine cause of variation
			Duplicate Analysis (reprep and analysis by same analyst)	3% of samples	Acceptable Analytical Variability from Table B-20	Re-examine grids to determine cause of variation; re-prep filter samples
			Interlaboratory Duplicates	5% of samples	Acceptable Analytical Variability from Table B-20	Re-examine grids to determine cause of variation; re-prep filter samples

Table B-19. (continued)

Matrix	Analyte	Method and Analytical Sensitivity	QA/QC Checks	Frequency	Acceptance Criteria	Corrective Action if Acceptance Criteria Not Met
	Total Fibers by PCM	NIOSH Method 7400; 0.001 f/cm^3 With 2400L	Blind recounts on reference slides	Daily	Per laboratory control charts	Investigate source of imprecision; re-count reference slides
			Blind recounts on filter samples	10%	See Step 13 of Method 7400	Investigate source of imprecision; re-count filter sample
Worker Air	Total Fibers by PCM	NIOSH Method 7400; 0.006 f/cm^3 (480 L) 0.003 f/cm^3 (960 L)	Blind recounts on reference slides	Daily	Per laboratory control charts	Investigate source of imprecision; re-count reference slides
			Blind recounts on filter samples	10%	See Step 13 of Method 7400	Investigate source of imprecision; re-count filter sample
	Asbestos by TEM	ISO Method 10312:1995; 0.005 s/cm^3	Lot Blanks	2% of unused filters	<10 asbestos s/mm^2	Reject filter lot
			Laboratory Blanks	Each sample batch	<10 asbestos s/mm^2	Collect and analyze clean area blanks; re-prep filter samples
			Laboratory Clean Area Blanks	Whenever laboratory blanks do not meet criteria	<10 asbestos s/mm^2	Find and eliminate source of contamination
			Replicate Analysis	3% of samples	Acceptable Analytical Variability from Table B-20	Re-examine grids to determine cause of variation
			Verification Counting	1% of samples	>80% true positives, <20% false negatives, <20% false positives	Re-examine grids to determine cause of variation

Table B-19. (continued)

Matrix	Analyte	Method and Analytical Sensitivity	QA/QC Checks	Frequency	Acceptance Criteria	Corrective Action if Acceptance Criteria Not Met
			Duplicate Analysis (reprep and analysis by same analyst)	3% of samples	Acceptable Analytical Variability from Table B-20	Re-examine grids to determine cause of variation; re-prep filter samples
			Interlaboratory Duplicates	5% of samples	Acceptable Analytical Variability from Table B-20	Re-examine grids to determine cause of variation; re-prep filter samples
Soil	Asbestos by TEM	EPA/600/R-93/116 (TEM) 0.1%	Laboratory Blanks	Each sample batch	Running average <18 s/mm^2	Find and eliminate source of contamination; re-prep samples
			Laboratory Control Samples (spiked standards)	Each sample batch	Acceptable Analytical Variability from Table B-20	Re-examine sample to determine cause of variation; re-prep samples
			Replicate Analysis	5% of samples	Acceptable Analytical Variability from Table B-20	Re-examine grids to determine cause of variation
			Duplicate Analysis	5% of samples	Acceptable Analytical Variability from Table B-20	Re-examine grids to determine cause of variation; re-prep samples
			Interlaboratory Duplicates	20% of samples	Acceptable Analytical Variability from Table B-20	Re-examine grids to determine cause of variation
	Asbestos by PLM	EPA/600/R-93/116 (PLM) 0.1%	Laboratory Control Samples (spiked standards)	Each sample batch	Acceptable Analytical Variability from Table B-20	Reprepare and re-examine sample to determine cause of variation
			Replicate Analysis	5% of samples	Acceptable Analytical Variability from Table B-20	Reprepare and re-examine sample to determine cause of variation

Table B-19. (continued)

Matrix	Analyte	Method and Analytical Sensitivity	QA/QC Checks	Frequency	Acceptance Criteria	Corrective Action if Acceptance Criteria Not Met
			Duplicate Analysis	5% of samples	Acceptable Analytical Variability from Table B-20	Reprepare and re-examine sample to determine cause of variation
			Interlaboratory Duplicates	20% of samples	Acceptable Analytical Variability from Table B-20	Reprepare and re-examine sample to determine cause of variation
	Asbestos by TEM (Soil Elutriation)	Elutriator; ISO 10312:1995; $1x10^6$ s/g_{PM10}	Lot Blanks	2% of unused filters	<10 asbestos s/mm^2	Reject filter lot
			Laboratory Blanks	1 per 10 samples or each sample batch	<10 asbestos s/mm^2	Collect and analyze clean area blanks; re-prep filter samples
			Laboratory Clean Area Blanks	Whenever laboratory blanks do not meet criteria	<10 asbestos s/mm^2	Find and eliminate source of contamination
			Replicate Analysis	3% of samples	Acceptable Analytical Variability from Table B-20	Re-examine grids to determine cause of variation
			Duplicate Analysis	3% of samples	Acceptable Analytical Variability from Table B-19	Reprepare and re-examine sample to determine cause of variation
			Elutriation Duplicate	2 samples	None established	Not applicable
			Elutriation SRMs	2 levels	None established	Not applicable
Settled Dust	Asbestos by TEM	ASTM D 5755-03; 250 str/cm^2	Lot Blanks	2% of unused filters	<10 asbestos s/mm^2	Reject filter lot

Table B-19. (continued)

Matrix	Analyte	Method and Analytical Sensitivity	QA/QC Checks	Frequency	Acceptance Criteria	Corrective Action if Acceptance Criteria Not Met
			Laboratory Blanks	1 per 10 samples or each sample batch	<10 asbestos s/mm^2	Collect and analyze clean area blanks; re-prep filter samples
			Laboratory Clean Area Blanks	Whenever laboratory blanks do not meet criteria	<10 asbestos s/mm^2	Find and eliminate source of contamination
			Replicate Analysis	3% of samples	Acceptable Analytical Variability from Table B-20	Re-examine grids to determine cause of variation
			Duplicate Analysis	3% of samples	Acceptable Analytical Variability from Table B-20	Reprepare and re-examine sample to determine cause of variation; re-prep filter samples
			Interlaboratory Duplicates	5% of samples	Acceptable Analytical Variability from Table B-20	Reprepare and re-examine sample to determine cause of variation; re-prep filter samples
Water	Asbestos by TEM	EPA 100.2; 0.05million str/liter hydrant 2 million str/ liter runoff	Lot Blanks	2% of unused filters	<10 asbestos s/mm^2	Reject filter lot
			Laboratory Blanks	1 per 10 samples or each sample batch	<10 asbestos s/mm^2	Collect and analyze clean area blanks; re-prep filter samples

Table B-19. (continued)

Matrix	Analyte	Method and Analytical Sensitivity	QA/QC Checks	Frequency	Acceptance Criteria	Corrective Action if Acceptance Criteria Not Met
			Laboratory Clean Area Blanks	Whenever laboratory blanks do not meet criteria	<10 asbestos s/mm^2	Find and eliminate source of contamination
			Replicate Analysis	1 sample	Acceptable Analytical Variability from Table B-20	Re-examine grids to determine cause of variation
			Duplicate Analysis	1 sample	Acceptable Analytical Variability from Table B-20	Reprepare and re-examine sample to determine cause of variation

Table B-20 Accepted Analytical Variability for Sample Re-Analysis*

Type of sample		Accepted Variability
Air Samples	replicate	1.96
	duplicate	2.24
	interlab duplicate	2.24
	co-located	2.50
Non-Air Samples	replicate	2.24
	duplicate	2.50
	interlab duplicate	2.50
	lab control	2.50

$$\text{*Analytical Variability} = \frac{|(\text{Analysis A}) - (\text{Analysis B})|}{\sqrt{(\text{Analysis A} + \text{Analysis B})}}$$

which is the absolute value of the difference of the two analyses, divided by the square root of the sum, which is an estimate of the standard deviation of the difference based on a Poisson counting model. For replicate air samples, for which the simple Poisson model is most directly applicable, the value 1.96 is chosen so that the criterion will flag approximately 1 replicate pair out of 20 for which the difference is due only to analytical variability, i.e., it has a "false positive" rate of 5%. For the other types of analyses, where greater natural variability is expected than indicated by a pure Poisson model, the criterion value has been increased from 1.96 in order to avoid flagging too many cases where the difference between the values is due only to normal variation, and not to any problem with either analysis. The values 2.24 and 2.50 were selected as targeting false positive rates of 2.5% (1/40) and 1.125% (1/80) for the Poisson model.

Example 1: For replicate air samples where A = 0 fibers and B = 3 fibers, the variation is considered acceptable, while A = 0 and B = 4 would be flagged for further investigation. Likewise A = 1 and B = 6 is acceptable, while A = 1 and B = 7 is flagged. At higher levels, A = 20 and B = 34 is acceptable, but A = 10 and B = 24 is flagged.

Example 2: For interlab duplicate non-air samples, A = 0 and B = 6 is acceptable, but A = 0 and B = 7 is flagged. Likewise, A = 1 and B = 8 is acceptable, but A = 1 and B = 9 is flagged.

B5.2.1.3 Laboratory Clean Area Blanks

Clean area blanks are prepared whenever contamination of a single laboratory prep blank exceeds the criteria specified in Section B.5.2.1.1or whenever cleaning or servicing of equipment has occurred. To check the clean area, a used filter is left open on a bench top in the clean area for the duration of the sample prep process. The blank is then prepared and analyzed by using ISO Method 10312:1995. If the blank control criteria (see Section B.5.2.1.1) are not met, the area is cleaned by using a combination of HEPA-filter vacuuming and a thorough wet-wiping of all surfaces with amended water. In addition, air samples should be taken in the sample prep room to verify clean air conditions. At least 2,500 liters of air should be drawn through a 25-mm-diameter 0.45-µm pore size MCE filter by using a calibrated air sampling pump. The samples should then be analyzed by using ISO Method 10312:1995. If blank control criteria are not met, sample preparation shall stop until the source of contamination is found and eliminated. Clean area sample results shall be documented.

B5.2.1.4 Replicate Analysis

The precision of the analysis is determined by an evaluation of repeated analyses of randomly selected samples. A replicate analysis will be performed on a percentage of the samples analyzed to assess the precision of the counting abilities of the individual analysts. A replicate analysis is a second analysis of the same preparation, but not necessarily the same grid openings, performed by the same microscopist as in the original analysis. The conformance expectation for the replicate analysis is that the count from the original analysis and the replicate analysis will fall within an acceptable analytical variability as shown in Table B-20,

B5.2.1.5 Duplicate Analysis

A duplicate sample analysis is also performed on a percentage of the samples analyzed to assess the reproducibility of the analysis and quantify the analytical variability due to the filter preparation procedure. A duplicate analysis is the analysis of a second TEM grid preparation prepared from a different area of the sample filter performed by the same microscopist as the original analysis. The conformance expectation for the duplicate analysis is that the counts from the original and duplicate analyses will fall within the acceptable analytical variability shown in Table B-20.

5.2.1.6 Verification Counting

Due to the subjective component in the structure counting procedure, it is necessary that recounts of some specimens be made by a different microscopist (i.e., a microscopist different than the one that performed the original analysis) in order to minimize the subjective effects. Verification counting will be done by more than one analyst in the initial laboratory and also by the QC laboratory. Counting will involve re-examination of the same grid openings by the participating analysts. Such recounts provide a means of maintaining comparability between counts made by different microscopists. These quality assurance measurements will constitute approximately 1 percent of the analyses. Repeat results should result in a level of consensus between laboratories such that both laboratories have >80% true positives, <20% false negatives, and <20% false positives in their verified counting analysis of asbestos structures.

B5.2.1.7 Interlaboratory Duplicates

The QC laboratory (RTI) will analyze a percentage of the air samples (TEM) as an independent check of the results of the primary laboratory (MVA). These analyses will be performed on a separate sector of the filter. The filter will be provided by MVA to RTI. The conformance expectation for interlaboratory QC checks is that the counts from the original analysis and the interlaboratory QC check will fall within the acceptable analytical variability shown in Table B-20.

B5.2.2 Soil Laboratory QC

B5.2.2.1 Laboratory Blanks

A laboratory blank is prepared by filtering 50 mL of water (the same type as used for sample suspension/sonication) through the same type of filter used to prepare TEM grids. A sample blank should be prepared each time a new batch of filters is opened and each time the filtering unit is cleaned. Blanks will be considered contaminated if they have a running average fiber loading greater 18 asbestos structures per square millimeter (EPA 1987). This generally corresponds to three or four asbestos structures found in ten grid openings. The source of the contamination must be found before any further analysis can be performed. Reject samples that are processed along with the contaminated blank samples and prepare new samples after the source of the contamination is found.

B5.2.2.2 Laboratory Control Samples

Laboratory control samples will consist of known amounts of chrysotile mixed in soil obtained from the Fort Chaffee demolition site at a concentration range of approximately 0.1%.

These samples will be prepared by the QC laboratory (RTI) and analyzed by REI with each sample batch.

B5.2.2.3 Laboratory Duplicates

A duplicate sample analysis is also performed on 5% of the samples analyzed to assess the reproducibility of the sample preparation and analysis. A duplicate analysis is the analysis of a second aliquot of the original soil sample.

B5.2.2.4 Replicate Analysis and Verification Counting

Replicate analysis will be performed on 3% of the samples as described for the air samples in Section B5.2.1.4.

B5.2.2.5 Interlaboratory Duplicates

The QC laboratory (RTI) will analyze 5% of the soil samples as an independent check of the results of the primary laboratory (REI). These analyses will be performed on a subsample of the soil which has been homogenized and prepared by the original laboratory.

B5.2.3 Settled Dust Laboratory QC

B5.2.3.1 Laboratory Blanks

A laboratory blank is prepared by filtering water through the same type of filter used to prepare TEM grids. A sample blank should be prepared each time a new batch of filters is opened and each time the filtering unit is cleaned. Blanks will be considered contaminated if they have greater than or equal to 10 asbestos structures per square millimeter. The source of the contamination must be found before any further analysis can be performed. Reject samples that are processed along with the contaminated blank samples and prepare new samples after the source of the contamination is found.

B5.2.3.2 Laboratory Duplicates

A duplicate sample analysis is also performed on a percentage of the samples analyzed to assess the reproducibility of the sample preparation and analysis. A duplicate analysis is the analysis of a second aliquot of the original dust samples aqueous suspension.

B5.2.3.3 Replicate Analysis

Replicate analysis will be performed on a percentage of the samples as described for the air samples in Section B5.2.1.

B5.2.3.4 Interlaboratory Duplicates

The QC laboratory (RTI) will analyze a percentage of the dust samples as an independent check of the results of the primary laboratory (REI). These analyses will be performed on a subsample of the dust aqueous suspension which has been filtered by the original laboratory.

B5.2.4 Water Laboratory QC

B5.2.4.1 Laboratory Blanks

A laboratory blank is prepared by filtering 100 mL of water through the same type of filter used to prepare TEM grids. A sample blank will be prepared with each sample set.

B5.2.4.2 Laboratory Duplicates

A duplicate sample analysis is also performed on one of the samples analyzed to assess the reproducibility of the sample preparation and analysis. A duplicate analysis is the analysis of a second aliquot of the original water sample.

B5.2.4.3 Replicate Analysis

Replicate analysis will be performed on one of the samples as described for the air samples in Section B5.2.1.4.

B5.2.5 Elutriator Sample Laboratory QC

B5.2.5.1 Laboratory Blanks

Laboratory blanks are unused filters (or other sampling device or container) that are prepared and analyzed in the same manner as the field samples to verify that reagents, tools, and equipment are free of the subject analyte and that contamination has not occurred during the analysis process. The laboratory will analyze at least one blank for every 10 samples or one blank per prep series. Blanks are prepared and analyzed along with the other samples. If the blank control criteria (Section B.5.2.1.1) are not met, the results for the samples prepared with the contaminated blank are suspect and should not be reported (or reported and flagged accordingly). The preparation and analyses of samples should be stopped until the source of contamination is found and eliminated. Before sample analysis is resumed, contamination-free conditions shall be demonstrated by preparing and analyzing laboratory clean area blanks (Section B5.2.1.3). Laboratory blank results shall be documented. Laboratory blank count sheets should be maintained in the project folder along with the sample results.

B5.2.5.2 Laboratory Duplicates

A duplicate sample analysis is also performed on a percentage of the samples analyzed to assess the reproducibility of the sample preparation and analysis. A duplicate analysis is the analysis of a second aliquot of the original elutriator filter sample.

B5.2.5.3 Replicate Analysis

Replicate analysis will be performed on a percentage of the samples as described for the air samples in Section B5.2.1.4.

B5.2.5.4 Elutriation Duplicates

The laboratory conducting the generation of the elutriator samples will duplicate a percentage of the soil samples to provide a measure of the precision of the sample generation procedure.

B5.2.5.5 Elutriation SRMs

To provide a basis for determining relative releasability of asbestos structures from soils and recovery of these structures during elutriation, soils from the site will be spiked with prepared asbestos standards at two concentrations. The preparation of standards will be accomplished by gently milling Standard Reference Material (SRM) asbestos standards for a predetermined amount of time. The milled material is weighed and analyzed by light and electron microscopy to determine the distribution of asbestos structures per gram of SRM material for all size ranges. A low and high amount of asbestos standard by weight is added to soil and blended gently into the soil by mixing. After conditioning, the soils are loaded into the elutriator tumbler and elutriated as per EPA method EPA 540-2-90-005, Modified May 23, 2000. Soils will be sieved through selective sieve sizes down to a 10 micron sieve. The final fraction is weighed to estimate the PM_{10} portion to the total weight of soil.

Results from the elutriator are reported in number of structures per gram PM_{10} of particulate released from the soil by the elutriation process. By knowing the number of structures per gram of SRM standard within the PM_{10} size range, based on fiber lengths less than or equal to 10 micrometers with widths less than or equal to 3.0 micrometers, an estimate can be made of the number of respirable fibers available for release from the PM_{10} portion of soil. This estimate can be compared to the actual number of structures per gram PM_{10} result from the elutriation. The ratio of the two results should give a recovery factor at 2 different concentrations.

B6 INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE REQUIREMENTS

B6.1 Field Instrumentation/Equipment

Field equipment/instruments (e.g., sampling pumps, meteorological instrumentation) will be checked and calibrated before they are shipped or carried to the field. The equipment and instruments will be checked and calibrated at least daily in the field before and after use. Spare equipment such as air sampling pumps, precision rotameters, and flow control valves will be kept on site to minimize sampling downtime. Backup instruments (e.g., meteorological instrumentation) will be available within one day of shipment from a supplier.

B6.2 Laboratory Equipment/Instrumentation

As part of the Laboratory's (MVA, REI, RTI, and Lab/Cor) QA/QC Program, a routine preventive maintenance program is performed to reduce instrument failure and other system malfunctions of transmission and scanning electron microscopes. The laboratory has an internal group and equipment manufacturers' service contract to perform routine scheduled maintenance, and to repair or to coordinate with the vendor for the repair of the electron microscope and related instruments. All laboratory instruments are maintained in accordance with manufacturer specifications and the requirements of ISO Method 10312:1995.

B7 INSTRUMENT CALIBRATION AND FREQUENCY

B7.1 Field Instrument/Equipment Calibration

B7.1.1 Air Sampling Pumps

Before the sampling pumps are used in the field, their performance will be evaluated by a qualified EQ industrial technician. The air sampling pumps, which are the primary air sampling item, will be evaluated to determine that they are capable of maintaining a stable flow rate for a given static pressure drop; i.e., the pressure drop created by a 25-mm, 0.45 µm MCE membrane filter with a 5 µm pore-sized MCE backup diffusing filter and cellulose support pad contained in a three piece cassette at a flow rate of 8 lpm @ STP.

The air sampling pumps with a flow control valve will be evaluated to ensure that they are capable of maintaining a stable flow rate for a given static pressure drop; i.e., the pumps can maintain an initial volume flow rate of within +/- 10% throughout the sampling period. Prior to use, the sampling pumps will be tested against the pressure drop created by a 25-mm-diameter 0.45-µm pore size MCE filter with a 5-µm pore size MCE backup diffusing filter and cellulose support pad contained in a three-piece cassette with 50-mm cowl at a flow rate of approximately 8 liters per minute at standard temperature and pressure (STP).

B7.1.2 Airflow Calibration Procedure

An in-line flow meter will be used to regulate the flow rate through the sampling train during sampling. The airflow rate will be determined both before and after sampling by using a calibrated in-line flow meter. The flow meter (a secondary calibration standard) will be calibrated by using a primary standard airflow calibrator (Gilabrator electronic flow meter or equivalent).

A detailed written record will be maintained of all calibrations. The record will include all relevant calibration data, including the following elements:

- Gilabrator model and serial number
- Flow meter model and serial number
- Sampling train (pump, flow control valve, and filter)
- X- and Y- coordinate calibration data

- Intercept, slope, and correlation coefficient from a linear regression analysis of the calibration data, and resulting linear regression equation that will be used to determine the sampling flow rate
- Relevant calculations
- Dry bulb temperature
- Name of person/affiliation that performed the calibration and linear regression analysis

B7.2 Calibration of TEM

The TEM shall be aligned according to the specifications of the manufacturer. The TEM screen magnification, electron diffraction (ED) camera constant, and energy dispersive X-ray analysis (EDXA) system shall be calibrated in accordance with the specifications in ISO Method 10312:1995, Annex B.

B8 INSPECTION/ACCEPTANCE REQUIREMENTS FOR SUPPLIES AND CONSUMABLES

B8.1 Air Sampling Filter Media

See Section B.5.2.1.1 regarding the quality control check of the filter media.

B9 NON-DIRECT MEASUREMENTS

No data are needed for project implementation or decision making that will be obtained from non-measurement sources such as computer data bases, programs, literature files, or historical data bases.

B10 DATA MANAGEMENT

Commercially available computer hardware and software will be used to manage measurement data to ensure the validity of the data generated. Controls include system testing to ensure that no computational errors are generated and evaluation of any proposed changes to the system before they are implemented. Commercially available software does not require testing, but validation of representative calculations is required by using alternative means of calculations.

B10.1 Data Assessment

Sample data will be reviewed by the laboratory during the reduction, verification, and reporting process. During data reduction, all data will be reviewed for correctness by the microscopist or analyst. A second data reviewer will also verify correctness of the data. Finally, the Laboratory Director at MVA, REI, RTI, or Lab/Cor (as applicable) will provide one additional data review to verify completeness and compliance with the project QAPP. Any deficiencies in the data will be documented and identified in the data report.

B10.2 Data Management

Field and laboratory data will be entered into a Microsoft Excel spreadsheet (or other applicable spreadsheet) to facilitate organization, manipulation, and access to the data. Field data will include information such as sampling date, sample number, sampling site, sample description and location, sample type, air volume, and sampling period. Laboratory data will include information such as sample number, sample date received and analyzed, type of analysis, magnification, grid location, grid square area, filter type, number of grids examined, number of asbestiform structures counted, structure type (fiber, bundle, cluster, or matrix), and structure length and width. An example format for reporting the structure counting data is contained in Figure 7 of ISO Method 10312:1995.

B10.3 Statistical Analysis

B10.3.1 Evaluation of Airborne Asbestos Concentrations

The proposed primary statistical method for comparison of airborne asbestos concentrations between the two methods is a two-sample t-test applied to the natural logarithms of the 18 airborne concentrations measured in the primary ring for each method; this method treats nondetect values as equivalent to measuring one-half a fiber in the sample. The proposed method depends on the assumption that the measured airborne asbestos concentrations follow a lognormal distribution. Goodness-of-fit tests such as the Kolmogorov test and the ShapiroWilk test will be used to test this assumption. Should such tests indicate that the normal distribution is a better approximation to the distribution of measured airborne asbestos concentrations than the lognormal, the t-test will be performed on the untransformed data rather than on the natural logarithms. Should neither the normal nor the lognormal distribution apply to the airborne asbestos data, nonparametric approaches will be used such as the Wilcoxon rank test, a nonparametric form of the two-sample t-test (Bickel and Doksum 1977).

While the two-sample t-test applied to the natural logarithms of the 18 airborne asbestos concentrations measured for each method at the 5-foot height in the innermost ring has been proposed as the primary statistical comparison, it is recognized that a rich dataset will result from the demolition experiment. For example, a variety of ancillary variables will be measured. The most important include wind speed and direction at 5-minute intervals, the location of the actual demolition activity as a function of time, and the position of the truck(s) for debris removal as a function of time. These variables can have a significant effect on the asbestos concentrations on the monitors. For example, a monitor that is downwind from the actual demolition activity when that activity is close to the monitor is likely to have a higher asbestos concentration than a monitor that is always upwind from the activity. Monitors close to the truck where debris is dumped for long periods of time are likely to show higher concentrations of asbestos. A regression model including the ancillary variables as predictors may therefore explain a significant fraction of the variability in the airborne asbestos concentrations, thereby increasing the power of the statistical analysis.

A second factor to consider is that airborne asbestos concentrations will also be measured at the 15-foot height in the inner ring and at the 5-foot height in rings 2 and 3. While it is expected, based on the dispersion modeling results, that the 5-foot samples in the first ring will have the highest asbestos concentrations, it is possible that the 15-foot samples, or the samples in the outer rings, could have higher values or at least values comparable to those at the 5-foot level in the inner ring. In such cases, it will be necessary to construct a more elaborate model accounting for all the airborne asbestos concentrations, and including the ancillary variables discussed above as well as the distances of the 3 rings from the building. This approach will ensure that all the data collected in the experiment is taken into account in assessing the comparability of the NESHAP and Alternative Methods.

In addition to the primary comparison, i.e., to determine if airborne asbestos concentrations from the Alternative Asbestos Control Method are statistically equal to or less than the Asbestos NESHAP Method, it is of interest to evaluate whether airborne asbestos concentrations downwind from the demolition are statistically greater than levels upwind. If they are not, then one can argue that asbestos concentrations from the demolition do not exceed background levels in the vicinity of the buildings. This question is of interest for the NESHAP Method as well as for the Alternative Method because few statistical evaluations of airborne asbestos concentrations from NESHAP demolitions have been conducted to date.

The most efficient design for comparing upwind and downwind concentrations would be to place monitors in paired locations upwind and downwind from the demolition, as opposed to the ring placement proposed at Fort Chaffee. A major shift in wind direction during the demolition could result in little or no useful data being obtained with the upwind/downwind approach. Given the considerable cost of experimental setup, staging, and demolition of a building, this is an unacceptable risk.

A possible approach to the upwind/downwind comparison using the data collected from the ring design is as follows. The hypothesis test to be conducted is:

$$H_0: \mu_2 \leq \mu_1 \text{ vs. } H_1: \mu_2 > \mu_1$$

where the null hypothesis H_0 is that airborne asbestos concentrations downwind from demolition do not exceed levels upwind. If H_0 is true, then the airborne asbestos level reported from a monitor should be independent of the amount of time the monitor is actually downwind during the demolition. That is, the airborne asbestos concentrations Y_1, Y_2, … Y_{18} should be independent of the percent of time $P_1, P_2, \ldots P_{18}$ each monitor is downwind during the demolition. Under the alternative hypothesis that airborne asbestos concentrations downwind from demolition are greater than upwind levels, $Y_1, Y_2, \ldots Y_{18}$ are positively correlated with $P_1, P_2, \ldots P_{18}$. The Spearman rank correlation test can therefore be used as a hypothesis test.[(6)] This test involves calculating a correlation between $Y_1, Y_2, \ldots Y_{18}$ and $P_1, P_2, \ldots P_{18}$ by replacing the observations with their ordered ranks.

B10.3.2 Evaluation of Post-Method Asbestos Soil Concentrations

In the evaluation of post-method asbestos concentrations in soil, similar analyses to those described above for the airborne asbestos comparison will be conducted to validate the assumptions of the two-sample t-test. If the assumptions do not hold, alternative nonparametric methods will be used.

The data collected during the building demolitions will be analyzed by using standard analysis of variance (ANOVA) techniques. The ANOVA is a formal statistical procedure that tests whether two or more groups of data are significantly different, on average. The natural logarithm of each sample concentration will be used in the comparisons. Log-transformation is used to make the variances more equal and to provide data that are better approximated by a normal distribution. The use of a log-transformation is equivalent to assuming the data follow a log-normal distribution; the log-normal distribution is commonly assumed for asbestos measurements and other environmental contaminants. Sample results reported as non-detected will be replaced by the analytical sensitivity divided by two to calculate summary statistics and to perform all statistical analyses. All statistical comparisons will be made at the 0.05 level of significance.

C ASSESSMENT/OVERSIGHT

C1 ASSESSMENT AND RESPONSE ACTIONS

C1.1 Performance and System Audits

C1.1.1 Field Audit

EPA-ORD (or their representative) who is independent of field activities will audit the field sampling and data collection activities at both the Fort Chaffee demolition site and the City of Fort Smith Landfill. The audit will include, but not be limited to, the examination of sample collection and equipment calibration procedures, sample labeling, sampling data and chain-of-custody forms, and other sample collection and handling requirements specified in the QAPP. The auditor will document any deviations from the QAPP so that they can be corrected in a timely manner.

Prior to leaving the site, the auditor will debrief the EPA-ORD Task Order Manager, EPA-ORD Quality Assurance Officer, and the EQ Project Manager regarding the results of the audit and any recommendations, if necessary. The results of the audit will be presented in a written report prepared by the auditor to the EPA-ORD Quality Assurance Officer and Task Order Manager.

C1.1.2 Laboratory Audits

Mr. Owen Crankshaw of RTI International will conduct one independent laboratory quality assurance audit of MVA, REI, and Lab/Cor with oversight by the EPA-ORD QA Officer. Prior to the audit, RTI will prepare a detailed checklist based on the approved QAPP. This checklist will be reviewed and approved by the EPA-ORD QA Officer. These audits will be conducted as soon after the laboratories receive the samples as practical to ensure compliance with the approved QAPP. The auditor will summarize the results of the audit(s) with input from the EPA-ORD QA Officer in a memorandum to the EQ Project Manager within two weeks of the audit. The memorandum will clearly spell out any areas in which corrective actions are necessary. If any serious problems are identified that require immediate action, the auditor will convey these to the EQ Project Manager verbally or through electronic mail on the day that such problems are identified. The laboratory will not analyze any samples until all audit recommendations have been resolved and documented in a memorandum to the EQ Project Manager. The EPA-ORD QA Manager will keep the EPA-ORD TOM informed of audit results and corrective actions.

C1.2 Corrective Action

Sampling and analytical problems may occur during sample collection, sample handling and documentation, sample preparation, laboratory analysis, and data entry and review. Immediate on-the-spot corrective actions will be implemented whenever possible and will be documented in the project record. Implementation of the corrective action will be confirmed in writing through a memorandum to the EQ Project Manager. The EQ Project Manager will then forward a copy to the EPA Task Order Manager.

C2 REPORTS TO MANAGEMENT

Effective communication is an integral part of a quality system. Planned reports provide a structure to inform management of the project schedule, deviations from the approved QAPP, impact of the deviations, and potential uncertainties in decisions based on the data.

The EQ Project Manager will provide verbal progress reports to the EPA Task Order Manager. These reports will include pertinent information from the data processing and report writing progress reports and corrective action reports, as well as the status of analytical data as determined from conversations with the laboratory. The EQ Project Manager will promptly advise the EPA-ORD Task Order Manager on any items that may need corrective action.

A written report will be prepared for each field and laboratory audit. The audit reports will be prepared by the person who conducts the audit. These reports will be submitted to the EPA Task Order Manager with a copy to the EPA ORD Quality Assurance Officer.

The final project report will be prepared in accordance with the guidelines specified in the EPA Handbook for Preparing ORD Reports, EPA/600K/95/002.

D DATA VALIDATION AND USABILITY

D1 DATA REVIEW, VERIFICATION, AND VALIDATION

The analytical laboratory will perform in-house analytical data reduction and verification under the direction of the laboratory's Quality Assurance Manager. The laboratory's Quality Assurance Manager is responsible for assessing data quality and advising of any data rated as "unacceptable" or other notations that would caution the data user of possible unreliability. The analytical results will be compared to the stated data quality indicators for each data quality objective.

Data verification and data validation will be conducted in accordance with EPA "*Guidance on Environmental Data Verification and Data Validation*," EPA QA/G-8 (EPA/240/R-02/004, November 2002. This will be performed by EQ's QA Officer.

Data verification is the process of evaluating the completeness, correctness, and conformance/compliance of a specific data set against the method or QAPP requirements. The goal of data verification is to ensure and document that the data are what they purport to be, that is, that the reported results reflect what was actually done.

Data validation is the analyte- and sample-specific process that extends the evaluation of the data beyond data verification. Data validation continues with the review of the raw analytical data and analysis notes. The data review will identify any out-of-control data points and data omissions. Based on the extent of the deficiency and its importance in the overall data set, the laboratory may be required to re-analyze the sample. Included in the data validation of a sample set will be an assessment of chain-of-custody and analyses of field quality control samples (opened and closed field blanks). Analytical data not appearing to be valid or not meeting data quality indicators will be flagged and reported to the EQ Project Manager. The EQ Project Manager will then transfer this information to the EPA Task Order Manager.

D2 DATA AND SAMPLE ARCHIVAL

Data and sample storage encompasses an archival of all collected samples, generated electronic files, and any laboratory notes collected during collection or analysis of samples. Upon completion of the analysis, the respective laboratory will store the remaining portions of the samples or sample preparations (e.g., TEM grids) until such materials are requested to be shipped to EPA. *Note: No samples or sample preparations will be discarded.* Following submission of the final project report, all laboratory and field records/files (paper and electronic) will be transferred to the EQ Project Manager. The EQ Project Manager will then transfer the complete project file to the EPA-ORD Task Order Manager for permanent retention.

E1 REFERENCES

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3. California Environmental Protection Agency Air Resources Board. Sampling for Airborne Naturally Occurring Asbestos at Oak Ridge High School, June 2003. (Report dated November 6, 2003).

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11. U.S. EPA. AHERA, 40 CFR Part 763, FR Vol. 52, No. 210, Oct. 30, 1987.

APPENDIX A

ALTERNATIVE ASBESTOS CONTROL METHOD

Developed by EPA Region 6 and EPA Office of Research and Development (ORD)

November 1, 2005 version

Background

In response to Section 112 of the Clean Air Act which requires EPA to develop emission standards for hazardous air pollutants, EPA promulgated the National Emission Standards for Hazardous Air Pollutants (NESHAP). 40 CFR Part 61 Subpart M (Asbestos NESHAP) specifically addresses asbestos, including demolition activities.

Asbestos NESHAP regulations require that all regulated asbestos-containing materials (RACM) above a specified amount be removed from structures prior to demolition. Asbestos-containing materials (ACM) are defined as those materials containing more than one-percent asbestos as determined using the method specified in Appendix E, Subpart E, 40 CFR Part 763, Section 1, Polarized Light Microscopy (PLM). RACM includes friable ACM, Category I non-friable ACM that have become friable, Category I non-friable ACM that will be or has been subjected to sanding, grinding, cutting, or abrading, and Category II non-friable ACM that have a high probability of becoming or has become crumbled, pulverized, or reduced to powder by the forces expected during demolition operations. Asbestos removal can account for a significant portion of the total demolition costs. In many cities, the cost of asbestos removal prohibits timely demolitions and results in substandard structures which become fire and safety hazards, attract criminal activity, and lower property values.

For structures that are structurally unsound and in imminent danger of collapse, the Asbestos NESHAP requires that the portion of the structure which contains RACM must be kept adequately wet during demolition and during handling and loading of debris for transport to a disposal site. No other engineering controls are required.

This Alternative Asbestos Control Method was developed by EPA as an alternative work practice to the Asbestos NESHAP, where certain RACM are removed prior to demolition and other RACM are left in place. The goal is to provide significant cost savings while achieving an equal or better standard of protection of human health and the environment. This method is much more restrictive than the Asbestos NESHAP requirements for buildings in imminent danger of collapse.

Applicability

This Alternative Asbestos Control Method applies to any structure subject to the Asbestos NESHAP regulation (i.e., structures that meet the definition of facility under the Asbestos NESHAP), except as noted below.

The size of structures which can be demolished using this method is limited to three stories or less (maximum height of 35 feet). This allows adequate wetting of both the interior and exterior of the structures and is within the working reach of both the wetting and the demolition equipment.

Building Inspection /Asbestos Assessment

A comprehensive inspection of the interiors and exteriors of structures to be demolished shall be conducted in accordance with EPA's Asbestos Hazard Emergency Response Act (AHERA, 40 CFR Part 763). Specific criteria for inspection, sampling, and assessment are in Subpart E (763.85, 763.86, and 763.88, respectively). The inspection shall be performed by an accredited asbestos building inspector.

Asbestos Removal

The table below summarizes the ACM that may be present in buildings and whether or not the ACM must be removed prior to demolition.

Asbestos-Containing Material	Removed Prior to Demolition?
Thermal System Insulation (TSI)	
▪ tank insulation	Yes
▪ pipe insulation	Yes
▪ elbow/fitting/valve insulation	Yes
▪ boiler insulation	Yes
▪ duct insulation	Yes
▪ cement and patching compound	Yes
Surfacing Material	
▪ mastic for flooring	No
▪ asbestos-impregnated plaster, stucco	No
▪ spray-applied fireproofing	Yes
▪ spray-applied surface coatings (popcorn ceiling, vermiculite treatments)	No
▪ spray applied acoustical or decorative surfacing.	No
▪ troweled-on crows foot texture, splatter texture, and joint compound.	No
▪ spray-applied surface coatings crows foot texture, splatter texture, etc.	No
▪ window caulking	No
Miscellaneous Material	
▪ fire curtains in auditoriums	Optional
▪ fire doors	Optional
▪ vibration-dampening cloths	No
▪ asbestos-cement tiles, sheets, roofing shingles, and transite	No
▪ asbestos-impregnated roofing cement and asphalt roofing	No
▪ shingles	No
▪ linoleum or other floor tile	No
▪ roll flooring	No
▪ ceiling tile	No
▪ asbestos-impregnated pipe	No
▪ vermiculite insulation	Yes

All TSI and spray-applied fireproofing shall be removed due to the inability to adequately wet these materials during demolition. Fire curtains may be removed if it is easier to do so than to adequately wet and handle this heavy material.

Vermiculite insulation, if present, shall be removed prior to demolition as an RACM, regardless of the measured asbestos concentration.

All asbestos removal operations shall be performed in accordance with state and federal law by a licensed asbestos abatement contractor.

Demolition Practices

Several demolition work practice standards shall be employed to ensure that the method is protective of human health and the environment. These standards involve the equipment used, the wetting process, the demolition process, and visible emissions. Demolition contractors shall provide an Asbestos NESHAP-trained individual to oversee the demolition process.

Equipment Used

Track hoes and rubber-tired end loaders shall be used during demolition to minimize the generation of dust. No bulldozers, explosives, or burning will be permitted.

Wetting Process

Structures to be demolished will be thoroughly and adequately wetted with amended water (water to which surfactant chemicals have been added) prior to demolition, during demolition, and during debris handling and loading. Surfactants reduce the surface tension of the water, increasing its ability to penetrate the ACM. Amended water will be prepared as a 0.16 percent solution (one ounce to five gallons) of a 50:50 mixture of polyoxylene ester and polyoxylene ether, or equivalent, in water as recommended in EPA-560/5-85-024, Guidance for Controlling Asbestos-Containing Materials in Buildings.

For this method, the Asbestos NESHAP definition for "adequately wet" will be used. That is, "sufficiently mix or penetrate with liquid to prevent the release of particulates. If visible emissions are observed coming from the asbestos-containing material (ACM), then that material has not been adequately wetted. However, the absence of visible emission is not sufficient evidence of being adequately wet." The demolition contractor's Asbestos NESHAP-trained individual will verify that ACM are adequately wetted.

Amended water shall be applied with a minimum of two hoses. The water shall be delivered as a mist. Direct high–pressure water impact of RACM is prohibited.

The wetting process consists of three stages. In each stage, both interior and exterior wetting of the structure shall be performed. To the extent feasible, cavity areas and interstitial wall spaces shall be wetted during each of the wetting stages. On the day before the demolition, access openings shall be made into the attic spaces from the exterior. The structure shall be first pre-wet (until adequately wet) from the interior and then from the constructed exterior attic access openings to enhance water retention and maximize wetting effectiveness. This pre-wetting shall prohibit further access into the structure, because of safety concerns. The structure shall be re-wet (until adequately wet) from the exterior through the windows, doors, and attic access openings on the day of demolition prior to demolition. Finally, wetting (until adequately wet) shall be done during the demolition and during loading of debris into lined disposal containers.

Demolition Process

To prevent dust generation and fiber release, structures shall be demolished so that minimal breaking of material occurs (only what is necessary to fit into the waste disposal container). Additional compacting of the ACM in the waste haulers is not allowed. All demolition shall be completed in a timely manner that will allow the debris generated during that day to be completely removed from the demolition site for disposal.

Visible Emissions

The Asbestos NESHAP standard of "no visible emissions" shall be employed. Visible emissions means any emissions, which are visually detectable without the aid of instruments, coming from RACM or asbestos-containing material. This does not include condensed, uncombined water vapor. The demolition contractor's NESHAP-trained individual shall verify the absence of visible emissions and has the authority to stop work if visible emissions are observed. During a demolition, it is often not possible to distinguish visible emissions from ACM and those from construction debris; therefore, should a visible emission be observed, the demolition effort shall pause until the deficiencies in the application of the wetting controls eliminate the visible emission.

Weather Restrictions

Demolition activities shall be delayed/halted in the case of any inclement weather that will impede the demolition contractor's ability to adequately wet the structure (e.g., freezing temperatures).

In addition, if visible dusting is observed in the vicinity of the demolition site, the demolition shall be delayed/halted.

Monitoring Requirements

Demolition contractors are required to comply with all applicable OSHA (29 CFR 1926) regulations for worker protection during asbestos removal and demolition activities. This includes the use of personal protective equipment (PPE) such as Tyvek suits or equivalent, respirators (as necessary), and gloves (as necessary); and personal monitoring.

Because, like the Asbestos NESHAP, this method is designed to be a work practice standard, monitoring of air (other than that mandated by OSHA statute), soil, and other media is not required.

Waste Handling

Several wastes are generated during demolition activities, including demolition debris, disposable PPE, and potentially contaminated water and soil, and must be properly disposed. All wastes generated must be removed from the site at the end of the day and transported to an appropriate disposal facility. Transport and disposal shall be in accordance with all federal, state, and local requirements. All waste haulers shall be leak-proof. Double-lining of the haulers with 4-mil or thicker polyethylene film and then sealing the top seams of the film is a suggested mechanism, but the contractor must do what is required to prevent leaks from the transport vehicles. Vehicles shall be decontaminated within the bermed area before leaving the demolition area.

Demolition Debris

Segregation of portions of a structure that may contain RACM from portions of a structure that clearly do not contain RACM shall be done when practical in an effort to minimize RACM debris. For example, segregation may be used if a large warehouse is being demolished and only a small portion (e.g., office space) contains RACM.

When segregation is not practical, all demolition debris shall be disposed as RACM in a licensed asbestos disposal facility. Debris shall be kept adequately wet during loading into containers. Containers shall be covered during transport.

PPE

All disposable PPE shall be disposed as RACM.

Potentially Contaminated Water and Impervious Surfaces

No potentially contaminated water runoff is permitted from the site during the demolition period. All impervious surfaces will be thoroughly washed with amended water before site closure. Construction site best management practices shall be used to prevent water runoff. Drains and sewer connections must be capped or plugged prior to wetting. Berms must be created as necessary to prevent runoff of water from the demolition site. The berm must be sufficiently spaced from the building to permit the movement of the demolition equipment and to allow the truck loading to occur within the enclosed space. If large water volume use or impermeable conditions surrounding the building create excessive water volume and simple containment and percolation is not feasible, the water must be pumped and either disposed as ACM or filtered through a series of filters ultimately removing all fibers equal to or larger than five microns before discharge to the neighboring environment.

Potentially Contaminated Soil

Following the removal of demolition debris, bare soil within the bermed area shall be excavated to a minimum depth of two inches or until no debris is found. Berms created shall also be removed and disposed as potentially asbestos-contaminated. All removed soil shall be disposed as RACM.

Site Closure

Following demolition and waste disposal, all waste and debris must be gone from the site and the site must be secured so as not to create a safety hazard.